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BULLETIN
OF
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REFLECTIONS ON THE RELATION OF THE CURRICULUM TO CERTAIN PROBLEMS IN MEDICAL EDUCATION

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It is with some hesitation that I place in print the thoughts contained in this paper, for discourses on educational policy belong more properly to the province of specially delegated administrative authorities. However, since it is only through the interplay of individual impressions and opinions that a satisfactory evaluation of educational methods can be attained, it cannot be entirely out of place for those who are devoted to the immediate act of teaching, and who are able to view the operation of educational systems intimately but at a distance from the difficult and many-sided complexities which surround the administrator, to record their own carefully considered impressions, not in a spirit of petty cavil, but in the sincere desire to further in an active way the general cause of education as well as the particular efforts of the administrators in their striving toward the best solutions of the problems. It was in this spirit that the present paper, which was not originally written for publication, was submitted to the Survey Committee of the Johns Hopkins Medical School in response to a request for criticisms and opinions, and it is published here at the suggestion and advice of the Chairman of that Committee.

I

Most of the various forms of organized human endeavor pass through alternating periods of quiescence and of flux. In certain instances, minor periods of flux have been created out of hand by the stirrings of single individuals who have sought to serve their own ends by introducing a new order. The effects of such individual impulses, since they are in essence artificial, are usually only fleeting and of little far-reaching import. While it is true that the fluid spirit of the times can be crystallized into a definite form by the work of a single individ-

ual, the periods of flux which are of permanent importance in the history of the form of a particular activity are those which have their origin in a widespread and spontaneous feeling that the existing form is inadequate to permit the fullest and best expression of the purpose of the endeavor by those engaged in its pursuit at that particular time. This feeling grows in intensity until it leads to an extensive application of thought and of energy in the effort to render the form of the endeavor more suitable to the existing demands. Experiment is applied; decided changes, often unduly radical or reactionary in character, are tested freely until a modified form comes to be regarded as enough of an improvement over the pre-existing one to permit a temporary relaxation of effort. Then ensues another period of quiescence, during which the form of the activity remains fixed in a rather clearly definable shape until, once again, a new generation finds the outlines, laws or dimensions inadequate, believes that they can and should be rendered more satisfactory by modification or change, and a new period of flux is born.

It is not to be thought that the periods of quiescence—the periods during which the external form of the activity remains more or less fixed—are necessarily periods of standstill in the progress of that activity. On the contrary, the purpose for which the external machinery exists is often best served during the periods in which the machinery is allowed to work smoothly, quietly, in a rather stereotyped manner, and without interference. It is, therefore, important to distinguish clearly between development in the *form* of an activity and development in the *purpose* of that activity, and to realize that either progress or retrogression in the purpose may occur quite independently of the particular state of the form under which the activity happens to be operating. The happiness of a people, for example, may be either increased or decreased by the change from a monarchical to a democratic form of government; laws of harmony and of counterpoint may be extended and improved without leading to the production of works finer than those of earlier composers who were bound by a simpler and more restricted form; painting, by a process of liberation of technique and of subject-matter, may pass from the work of the Italian primitives to the masterpieces of the Renaissance, but in other hands at other times it may also, by the same general process

and philosophy of liberation, pass to the monstrosities of "modern" art; liberation of the form of architecture may produce the flowers of the French Renaissance or it may foster the development of the Baroque; restriction to a more geometrical form may be responsible for the Parthenon or for the block-house sky-scraper; and, undoubtedly, medical education may succeed or may fail in its purpose of training great physicians and investigators irrespective of the restriction or of the freedom of the form of the curriculum which shapes its external movements.

This is but another way of saying that by far the most important of the factors which determine the character of the product of an endeavor is the character of the individuals who are engaged in it. In the training of competent medical men, masterful teachers and the proper type of student are matters which far outweigh in importance the character of the curriculum. The form of the curriculum may be straight-laced, or it may embody the best ideals of *Lern-* und *Lehrfreiheit*; if the teachers are masters of their material and gifted with the power of arousing interest in it, and if the students are intelligent, able and responsive, highly competent men may be produced regardless of the order in which the subjects are arranged, or of the number of study-hours proclaimed to be necessary by the curriculum committee. Indeed, if the student be gifted with unusual ability, he can without any doubt prepare himself satisfactorily for a distinguished career even if the curriculum under which he labors is abominable and his teachers dull and uninspiring. I should like to state clearly at the outset that I do not believe that it is either necessary or wise to plan medical education for the convenience of the exceptional, highly gifted student. Such rare individuals will always take care of themselves no matter what the system may be under which they find themselves. Whether the curriculum is overcrowded with required courses or relatively free, whether the courses are dogmatic or liberal, whether a close check is kept of their activities or whether they are left to their own devices—these matters will not seriously affect the really exceptional students. Being able to acquire information rapidly, they have always had time to spare for investigation or for extraneous scientific or cultural pursuits no matter what has been the state of the curriculum schedule, and they always will have; for such individuals have a way of taking into their

own hands the matter of shaping their own lives and they are ordinarily quite nonchalantly unconcerned about curriculum rules. The worries of the curriculum committee should be small indeed if it had merely to plan for the exceptional, highly gifted students. As earnestly as we may desire that all or most of our students be of this type, common sense tells us plainly enough that the vast majority are not. There are at the most only two or three in each class of seventy students. For these, as I have said, we need not and should not plan the curriculum as long as our attitude toward such self-sufficient individuals is properly liberal. For the group of poor students at the bottom of the class we certainly should not plan our schedule. A curriculum will serve its greatest purpose only when it is planned wisely for the guidance of the average good student—the type which makes up the majority of the young men with whom we have to deal. With proper care quite a few of these may be raised to a high level of intellectual independence, whereas under unfavorable conditions the development of this group may be seriously retarded.

Under any circumstances the overwhelming share of responsibility for his development must always rest directly upon the student himself.[1] However, in spite of the cynical pretensions of a matter-of-fact age, it will always remain vitally true that inspiring teachers can be of the greatest help in guiding and in encouraging even (or, perhaps, one should say "especially") the highly gifted student toward a more certain accomplishment; and the influence of the master, indefinable though it often may be, is nevertheless usually plainly enough apparent to the disciple. It is less common that the student, adult though he be when be engages in his medical studies, analyzes or properly evaluates the form of the curriculum under which he engages to study. Ordinarily, and even when it is a wretched one, he regards it as a more or less

[1] Taine, in his magnificent lectures, was accustomed to impress this upon his students by saying: "As to precepts, we have as yet found but two: the first is to be born a genius, an affair of your parents, and not mine; and the second, which implies much labor in order to master art, which likewise does not depend on me but on yourselves. My sole duty is to offer you facts, and to show you how these facts are produced." There is, however, a further duty of the teacher—to interpret his facts in an interesting and stimulating manner, a duty to which Taine, himself was in no sense blind, for we find him opening his lectures with general remarks about "the subject with which I intend to *entertain* you this year."

inevitable course, thoughtfully planned for his best interests by persons of greater experience who have at heart the desire for his proper advancement; and as such he accepts it with what often appears to be surprisingly little questioning.

For this relative lack of critical interest in the curriculum, however, the student can hardly be blamed. In our American universities, in the catalogues of most of which some sort of definitely ordered curriculum is prescribed, the student has most certainly a right to expect that the mechanical form of his education will be properly and wisely arranged for him; and besides, although he may know instantly whether a particular teacher is a good or a poor teacher, it is by no means so easy for him, coming for the first time into contact with a particular subject, to know whether that subject could be studied more profitably before or after having studied another subject, or whether more or less time is necessary for the proper acquisition of the basic principles involved. Ordinarily, therefore, it is only in the case of the grossest deficiencies in a curriculum that the opinion of the student is of value. As much as one would desire to regard the medical student as an adult individual who knows what is best for himself, and, accordingly, to arrange the curriculum from that standpoint, under the present conditions of preliminary education in America such an attitude cannot wisely or profitably be adopted. From the fact that many eminent men were produced some seventy years ago in Germany under the conditions of a certain freedom of learning in medical schools in the scheme of which ordered curricula scarcely existed, it does not at all follow that the poorly disciplined and less mature American college graduate of today will thrive best under such a system. Even if we chose to ignore the wholly different character of the immediate environment which surrounds the American medical student—an environment different in the degree of economic and competitive pressure, in cultural ideals, and in the value set upon academic distinction and creative accomplishment, to say nothing of the necessarily different intellectual atmosphere of today as contrasted with that which surrounded the birth of scientific medicine—it would be highly unwise to ignore the effect which fifteen years of previous exposure to an incompetent educational system has exerted upon our medical students' attitude toward independent study before they enter the medical school.

Although the external form of the curriculum plays only a subordinate rôle in shaping the product of the medical school, it is nevertheless true, I believe, that the rôle which it may play can be sufficiently important to warrant the application of the most careful thought to the matter; for under the circumstances which are in operation today it is quite possible to hamper seriously the best development of the student by an improper curriculum. Even if there were any question about the direct effect of an unwisely organized curriculum upon the student, it must not be forgotten that such a curriculum can react indirectly upon the student through the important channel of the character of the teaching to which he will be exposed; for it is very distinctly possible to discourage and to hamper the best teaching of a subject by forcing the subject into an illogical place in the curriculum, by designating for its pursuit either inconvenient or awkwardly arranged hours, or by an injudicious decision as to the total amount of time to be devoted to the teaching of it. Indeed, in the shaping of a curriculum, it is in general a sounder principle to proceed from the standpoint of serving the best interests of the *teaching* of the subjects rather than of serving the best interests of the *learning* of the subjects. This is no idle paradox. It is not at all unknown that in certain instances curriculum committees, occupied too closely with the theoretical problem of the manner in which the student can learn best, have defeated their own ends by weakening greatly the stimulus to good teaching in various subjects through a careless disregard of the basic external requisites for the proper teaching of those subjects. On the other hand, I think that it is safe to say that if thoughtful attention is given primarily to the arrangements which will be most suitable for the proper teaching of a subject, those arrangements will never conflict seriously with requirements of the proper learning of that subject.

The general form of medical education which, for about twenty years, has remained fairly rigidly crystallized, finds itself at the moment in the midst of an active period of flux. This present state of flux, characterized by a widespread focusing of interest and discussion upon problems of curriculum and by the resort to all manner of experiment, is no unimportant movement ushered in by an artificial or trumped-up need. A few years ago it began to be felt that the curricula of the medical schools in the United States could no longer be

regarded as satisfactory systems of medical education. There were certain circumstances which forcibly directed the attention of all interested in the matter to the desirability of attempting a reform of some sort. The most obvious of those circumstances were the changed face of the subject material which has to be taught, and the changed conditions which surround the finished product of the medical school—the graduate doctor. During the past twenty years of relative stasis in the form of the curriculum, the character of the progress of medical science in its various branches has necessitated a revision of our attitude toward the value of many of the courses in the curriculum; the development of extreme specialization in practice and in research, unfortunate as one may regard it, is nevertheless a *fait accompli* and a situation which has to be reckoned with in any consideration of the training of the medical student. Both the road and the goal of the medical student are different today from what they were twenty years ago—different enough to make one realize that the general form of the curriculum of twenty years ago may profitably be modified to meet the changed conditions. Besides these obvious reasons for the inauguration of the present period of flux there is, in the minds of many persons who give thought to the matter, the feeling that, in spite of the large numbers of medical students graduated each year, the production of able leaders has fallen sadly short in almost every field. I think that few would pin their hopes of training great leaders of medical thought upon the arrangement of the medical school curriculum, but nevertheless it is clearly desirable, in the effort to provide every possible facility for the development of such men, to give careful thought to the proper educational development of students of medicine as a whole.

II

Whatever other ends a medical school curriculum may serve, there are at least three fundamentally important ones:

First, to provide the student with an opportunity to become familiar with those basic principles which should form the foundation upon which later experience will rest.

Second, to provide an opportunity for the best development of each individual student toward the particular branch of medicine in which he will be active after graduation.

Third, to provide for the satisfactory accomplishment of the first two purposes in as brief a time as possible, so that the period of passive absorption of information may give place as soon as possible to that active acquisition of information which, alone, constitutes experience in the true sense.

Unfortunately, these three purposes of a curriculum, although so easily stated, neverthless embody certain concepts which are by no means easy to define in a clear-cut way, or to interpret in a manner satisfactory to all concerned. Regarding the first of the purposes listed above, for example, any attempt to form a curriculum must very soon run afoul of the difficulty of defining satisfactorily just what constitutes the basic principles with which the student should be required to become familiar. A comparison of the curriculum announcements of different medical schools will provide abundant evidence that wise men, deeply interested in medical education, can entertain widely divergent views upon the matter. As for the amount of time to be devoted to each subject, it is only in the case of a most distorted sense of values that a man who holds the interests of his students sincerely at heart can fall innocently into the error of attempting to appropriate a manifestly undue amount of the student's time for his own course. The enlightened professor with a true feeling for the best development of the student desires only that his subject shall occupy a properly balanced place in the curriculum. But even such men, with a level sense of values and with the best possible intentions, often find it very hard to decide upon the subjects which are to be regarded as necessary for an adequate foundation, or to agree upon what constitutes a just division of the student's time.

III

Difficulties are encountered also in the attempt to interpret in the proper way the second of the purposes of a curriculum which I have mentioned above. Several important considerations are involved in the attitude which desires to permit a free development of each student toward the branch of medicine which he may pursue after graduation. It is important in the first place to weigh carefully the question whether the student should be encouraged to decide early in his course what specialty he will follow after graduation, or whether he should be

encouraged to defer that decision until he has had an opportunity to discover his particular bent as he progresses open-mindedly through an ordered curriculum. The attitude which will be adopted in regard to this question must be determined largely by one's opinion as to the frequency with which students find it possible to decide intelligently upon their future specialization early in their medical school course. Certainly there can be no doubt that the sooner a man reaches a definite and satisfying decision regarding the exact character of what is to be his life work, the better will be his opportunity to direct his best energies toward the attainment of the things which he desires from life. It by no means follows, however, that any decision, adopted merely for the sake of making a decision, will be productive of good. The decision must be both intelligent and satisfying; that is, it must be closely fitted to the desires and the talents of the individual in question. Can one expect medical students to be able to reach such a decision early in their school course? There are those who believe that they can. Indeed there are even some who maintain that most medical students know when they enter medical school what specialty they wish to follow after graduation. Others believe that, by encouraging the student to attempt to make a decision, most of them can be brought to decide early in their course. In my own opinion, formed from observation and from many pointed conversations with many students, the vast majority of students are completely unable to decide upon their future specialization in a satisfying way before their last year in medical school and, indeed, perhaps only a relatively few reach a truly satisfying decision then. The student who enters medical school with a clear and unalterable determination of the field of his future life-work is so rare that, for purposes of curriculum consideration, he can well be ignored. It is a common observation that many students questioned early in their course confess a preference for surgery—not because they intelligently recognize in themselves a distinct talent in that direction, but merely because the student when he enters medical school is a layman, and to the average layman surgery is glamorous. Many of those who, on entering medical school find pleasure in visualizing themselves as surgeons, become aware of unsuspected attractions in fields other than surgery during their four years of study, and they turn to these other fields in preference after graduation.

Few who converse intimately with students hold the belief that they are able to decide upon their future work intelligently early in their course. Indeed, how can they be expected to reach a satisfying decision before having had a fair contact with the various important subjects which are hardly broached before the third or fourth year? It must be obvious to any observer that in spite of the most earnest effort to discover their particular bent, a large number of students have not succeeded, even at the time of graduation, in reaching a clear-cut decision regarding the branch of medicine which they wish to follow for the rest of their lives. It must not be thought that the excellent student is any the more able to reach a decision than are his less capable fellows. Indeed, the decision is often particularly difficult for those who think deeply and intelligently about the matter. Conversation with not a few of the most gifted and outstanding men in various branches of medicine will bring out plainly enough that the fields in which they have so brilliantly displayed their talents were the last to which, during their medical school course, they would have dreamed of devoting their lives. Accidental influences are very often the deciding factors in determining what interneship an individual accepts after graduation. It is not unusual that, desiring to complete his training in the environment in which he studied, a fourth year student who believes that he prefers a certain specialty accepts an interneship in a totally different type of specialty, and remains permanently in that field, if he fails to win an appointment to the service which he preferred. Or again, the student may enter a particular service chiefly because of the attraction of some one individual on the upper staff with whom he has become friendly, or who has expressed an interest in his future; and numerous other accidental circumstances having nothing to do with the student's clear-visioned choice are familiar to everyone.

If it is difficult for a student who knows that he wishes to enter the *practice* of medicine to decide what branch of medicine he wishes to practice, a decision is doubly difficult for those students who feel the desire to achieve a career in a preclinical subject, for here the talent of the individual and his desire for the pleasures of the particular field are not the only considerations which have to be weighed. One has year after year the opportunity to observe the mental struggle of the average

young man who leans toward a career of investigation in a preclinical subject. Against his desire to embrace the career arise disturbing doubts as to his untried investigative ability. He knows that if he enters the clinical side he will have more or less of an opportunity there to try out his investigative powers while ably fitting himself for the practice of medicine, to which he can turn at any time for a livelihood if necessary; whereas, if he enters a preclinical branch, his ultimate existence will depend largely upon his investigative ability. Easy enough to say that he can "try out" his powers for a year or two and then turn to clinical medicine if necessary; but the saying of this merely emphasizes the fact that at the time of graduation many students cannot see their future course clearly. Even in the case of the student who has successfully tested his interest in investigation by engaging in research during his school years there arises the not easily dismissed problem of his future economic security. He knows that there will be long, lean years during his apprenticeship in a preclinical branch, and that at no stage of his progress will he have the earning power of men who are successful to the same degree on the clinical side. He is faced directly with the necessity of making a decision as to the amount of worldly possessions with which he can be happy—in other words, the decision as to whether he prefers to purchase with the rewards of his work an abundance of material things or an abundance of freedom to follow his intellectual desires. These and other problems of major importance to the individual are difficult enough to dispose of after graduation; it is impossible to expect students to be able to arrive at an intelligent solution early in their medical school work.

And yet, the present tendency of various medical schools is to arrange the curriculum in a fashion which will allow greater freedom to the student in the choice of electives throughout his course, so that each student who has decided upon his future may select courses which will be of value to him in the pursuit of the particular branch which he has decided to follow. But even in the case of those rare students who may reach a formal decision early in their medical course it is important to enquire whether, being given perfect freedom, they will be able to select wisely the subjects which will best further their development toward their chosen field. It is my belief that the student is not able to order his own course of study wisely. This is no

reflection upon the intelligence of the student. If venerable educators, familiar with the many problems and pitfalls through long experience, find so much difficulty in reaching concordant opinions as to the best course for the student to follow, what can one expect of the untried, fledgling student? One hears much of the virtue of regarding the medical student as a responsible "graduate student"—of permitting him the greater freedom of choice usually accorded the students of the graduate schools of universities, and of expecting from him the capacity for more independent choice which is to be expected of graduate students in general. However, the merest reflection should inform one that the student who enters medical school is in no proper sense of the term a graduate student. The medical school course is strictly an undergraduate course. The fact that the entering student may be required to possess a college degree in no way affects his undergraduate status as a medical student. A graduate student in the proper meaning of the term is one who pursues advanced work in a particular field after having acquired a satisfactory preliminary familiarity with the basic principles of that field. Whether or not he is in possession of university degrees outside that field does not in the least bear upon the question. It is obvious that the department of Romance Languages, for example, would hardly admit as a graduate student of Spanish a Bachelor of Science—nay, not even a Doctor of Philosophy!—who had never studied elementary Spanish. The student entering medical school approaches a field with which he has not the slightest preliminary acquaintance except for the slender connection between college zoölogy and human anatomy, and that between college chemistry and physiological chemistry. In the face of the many entirely new subjects and techniques of the medical school he is actually more of an undergraduate in the true sense than are the undergraduates in the arts and sciences, for they at least have had preliminary work in high school in the majority of the subjects which they will meet in the college.

A curriculum planned for medical students on the generous assumption that they are graduate students capable of independent choice and independent work must inevitably reveal, sooner or later, that neither age nor previous training in unrelated collegiate subjects can endow a man with adequate critique in the face of a totally new and untried type of endeavor. Indeed, it would be interesting to observe the

result if educators, themselves, equipped with their earned degrees of Bachelor of Arts, Master of Science and Doctor of Medicine, and with years of pedagogical experience in addition, were placed, let us say, in a school of engineering and given perfect freedom to choose from many electives their own course of study. It is highly probable that, unless they earnestly sought the advice of the Faculty or of competent engineers, their choice of subjects would, by and large, be as misguided as that of most medical students laboring under a too liberal curriculum. Of course, one might reply that the medical student under the liberal curriculum can, if he wishes, seek the advice of the Faculty in order to determine what subjects are best for his particular needs. There are, however, numerous real difficulties inherent in this apparent opportunity. First among them will always be the fact that most students, not being sure of their future course, cannot intelligently state their needs.[2] But, even in the case of the few students who possibly have reached a decision, the Faculty advisors will be faced with the important question as to whether or not specialization toward the ultimate goal should be begun in the medical school, and they will disagree among themselves on this question. There are those who believe that it should—that it is a waste of time and effort for students to dissipate their energies becoming acquainted with fields of medicine which do not bear directly upon their proposed life-work. I cannot in any sense share that view, and I am sure that many others are unable to share it. Intensive and narrowing specialization will restrict the breadth of outlook of the individual rapidly and surely enough after graduation, with-

[2] This year I placed the following question, with no comments, simultaneously before the first, second and third year classes of the medical school: "Have you decided which branch of medicine you will follow after graduation, and if so, which?" Thirty-two students, out of the one hundred and seventy-one who replied, believed that they had made a decision. Twenty-two per cent of the members of the first year class stated that they had definitely decided upon their future careers, but replies such as "Dermatology, including skin and cancer," and "Endocrinology," may serve to guard one against placing too much faith in these early expressions of decision. Of the second year class, only ten per cent claimed to have reached a decision, and only twenty-four per cent of the third year class. From observation of past classes of students I am quite sure that a large proportion of even this relatively small number who believe now that they have made a decision will find within a few years that they have changed that decision.

out our beginning the process within the walls of the medical school. I do not mean to suggest, of course, that the medical student should grasp frantically at innumerable minor courses in order to avoid specialization, for such a course obviously leads to confusion rather than to breadth of vision. But I do believe that there are quite a goodly number of courses which should be soundly taught, and the basic principles of which every medical student should be not only encouraged, but required to master to the best of his ability, regardless of what may be the field of his future career; and that the proper arrangement of the students' exposure to these courses should be the chief concern of the architects of the curriculum, rather than any arrangement of freedom of choice of subjects which may encourage too early specialization at the expense of the proper degree of breadth of elementary training.

In addition to the vice of too early specialization, human nature being what it is and preliminary education in America being what it is, a curriculum which permits too great freedom of choice tempts the student to choose only the subjects which are agreeable and to avoid those which are less agreeable.[3] Since, for many students, "agreeable" subjects are those which require less effort to learn, and "disagreeable" subjects those which require more effort, too much freedom of choice tends to encourage the escape from the valuable discipline which is to be gained by undertaking the responsibility of mastering important material which is not easy to master. It may be argued that character-building is not a function of a medical school, to which the students come as adults, but I think that few teachers truly interested in their work would agree to that. It has been the greatest pride of the greatest teachers not that they have taught the student a neatly arranged set of facts (few have had illusions as to the permanency of that achievement!)

[3] This, to say nothing of the tendency of many unguided students to waste very precious time in relative idleness—a tendency to which not even the highly disciplined German youth are immune. Thus, in 1892 Virchow, in an address on the occasion of his inauguration as Rector of the Friedrich-Wilhelms University in Berlin, felt it necessary to dwell at length upon the unhealthy reaction of many students to the German system of freedom of learning, and to point out that "*akademische Freiheit* bedeutet nicht *Freiheit in Nichtsthun*, nicht Freiheit im *Vergnügen* oder *in der Befriedigung der Leidenschaften*, sondern *Lernfreiheit*." (Virchow's italics.)

but rather that they have imparted to the student an *attitude* toward their subject, toward science in general, perhaps toward life.

In our desire to make the student free it is well to remember that all freedom beyond that which one is prepared to use wisely is, in the long run, frequently more harmful than salutary. In our eagerness to adopt the German concept of *Lernfreiheit* which seems so attractive at a distance, we should at least be on our guard against the common error of misinterpreting the intended spirit of that *Freiheit*. It may be well to quote here the words of Stricker on the subject, written in 1894:

"Ueber Eines dürfen sich indessen die Studenten nicht täuschen. Man versteht unter Lernfreiheit nicht, dass der Student lernen könne, *was er wolle*, die Freiheit besteht nur darin, dass er das, was ihm der Staat vorschreibt, lernen könne *wo er wolle*" (italics Stricker's).

Indeed, when one reflects that every German medical student is *required* to pass satisfactory examinations in botany, zoölogy, general chemistry, physics, anatomy, histology, physiology, physiological chemistry, pharmacology, therapeutics, pathology, medicine, surgery, obstetrics and gynecology, ophthalmology, psychiatry and hygiene, and to present in addition certificates of attendance at specified clinics and lectures in medicine, pediatrics, laryngology and otology, dermatology and legal medicine, it becomes evident that *Lernfreiheit* hardly means to the German the freedom of the student to select capriciously his own course of study. German medical educators themselves have long been aware of the dangers inherent in any system of freedom of learning which is not held within carefully supervised limits. Among many others, Puschmann forty years ago voiced this awareness in the conclusion of his well known history of medical education where he writes:

"Nirgends wirkt die unumschränkte Lernfreiheit so schädlich als in dem Studium der Medizin."

In short, I believe that the second of the purposes of a curriculum outlined above is to be best attained by a proper interpretation of the first, i.e., that the best development of each individual student toward the particular branch of medicine in which he will be active after graduation is to be achieved through a curriculum which *requires* the student to become familiar at least once with the basic principles of the major

fields of medicine, rather than by means of a curriculum planned to encourage too early specialization.

IV

As for the third purpose of a medical school curriculum, namely the accomplishment of the satisfactory basic training of the student *in as brief a time as possible*, this is a matter upon the importance of which I should like to place the very greatest emphasis. For the student who wishes to use his medical training simply as a means of earning a livelihood the question is important enough, for the undue postponement of the attainment of economic independence is undesirable; but for those who wish to pursue academic and investigative careers, the prolongation of the period of schooling is indeed a matter of the most serious moment from the standpoint of their proper intellectual development. There is no question in my mind but that the present scheme of education, which so greatly prolongs the period of schooling, is tending to damage seriously the material which it seeks to improve. That good doctors are being sent out yearly into practice there is no doubt whatsoever, and I do not in any sense intend to undervalue the importance of this accomplishment which depends upon the careful and thorough training of the student in the practice of medicine during and after graduation. On the contrary, the most thoughtful consideration should always be given to the encouragement of clinical perfection, for unless master clinicians are produced continually by the medical schools of the country, a time will surely come when the teaching of clinical medicine will rest in the hands of men unfit to impart it properly to the coming generations of students.

There are two main functions for which a university Faculty exists. The first, and primary one, is to keep alive and to pass on to succeeding generations the best of the accumulated knowledge of the subjects which it represents. The second is to improve, or, if possible, to add to the store of knowledge pertaining to those subjects. Clearly, it should be a general policy of university administration to ensure the proper accomplishment of the first of these functions before over-stressing the importance of the second; else there is grave danger of departments becoming merely research institutes: and research institutes, however important their work may be, are not universities. Too much insist-

ence cannot be placed upon the duty of the members of the upper staff of each department to keep alive, in their own persons, the best knowledge of the subject which they profess. A department which produces creditable contributions to the general body of knowledge may well be regarded as a failure from the university standpoint if its upper staff consists of men who are not masters of the subject which their department represents. The presence of many such men in a university will inevitably react unfavorably upon the development of the students and younger staff members, who are quick to conclude that mastery of a subject is held in less esteem than is the writing of papers about a restricted corner of a field; whereas, if mastery is encouraged by example, the university will be safe in its primary function, and without doubt those of the properly educated younger men who have talent and inclination toward research will find their way easily into it. During the past fifteen years, partly because of the rapid growth of experimental medicine and partly because of certain influences inherent in the full-time system, an undue amount of emphasis has been placed upon research in numerous medical schools at the expense of the insistence upon mastery as the fundamental requirement of appointment to the upper teaching staff. Research has become a fetich in many universities, and in medicine hundreds of young men who have had neither the aptitude nor the desire for investigation, have forced themselves (or, in certain instances, have actually been deliberately forced) into investigative work at the expense of their thorough training, because through investigation (not necessarily important investigation, it must be confessed) lay the more certain way to advancement. It is the opinion of many that various branches of clinical medicine may be suffering a greater loss from the decrease in expert clinicians than they are gaining from the innumerable papers which are being written by the younger generation of opportunists, many of whom held real promise of becoming masters of their field; and it is because of this that I have said that the most careful thought should be given to the problem of clinical training in order that both student and apprentice may realize that the promise of mastery of clinical medicine, as of other subjects, will be the first requirement of admission to the upper staff.

In spite of this emphasis upon the first function of a university Faculty, the second function—to extend as far as possible the knowl-

edge of the subjects which it represents—remains, of course, a vitally important one, and it is this function, especially, which our present educational system threatens most seriously. This may perhaps seem paradoxical or contradictory after what I have just said of the stress which is placed at present upon research in medical schools. The present system, however, is a damaging one not because of indifference to the carrying out of research, but because the undue extension of the period of schooling tends to frustrate the development of creative ability. Under the present scheme, pursuing what is regarded as a normal course through high school, college, medical school and several years of interneship, the age of twenty-eight or thirty is reached before the man who enters a university career begins to think and to work on his own responsibility. During his four years in medical school he works very much as he did in college, passively learning his lessons and memorizing material which he is required to know for his examinations. During the first year or two of his interneship, especially on the clinical side, he is so much occupied with his new duties and with the effort to orient himself in his chosen field that there remains little time for independent investigation. At the end of that time he is less rigidly supervised; indeed he begins, himself, to supervise the new internes, and his period of independent intellectual responsibility may be said to have begun. He also comes into more freedom from required duties, and he may with ease turn part of his attention to the investigation of problems which have aroused his interest. But at this important point in his career he finds himself at the end of those priceless years, the value of which in matters of intellectual development cannot be overestimated—the twenties. Instead of having had those years of unparalleled enthusiasm, energy, and confidence during which to form habits of independent thought and to throw himself into the business of shaping his career, he has used them up in sitting upon lecture-room benches listening to the words of schoolmasters, and in performing tasks set him by other persons in authority. It is useless to offer neat schemes of "freedom of learning" in medical schools as a corrective for this unfortunate situation. Independent work and the proper development of habits of independent thought will hardly begin before the moment at which the individual finds himself standing alone on his own merits, with no one owing him any sort of intellectual pro-

tection or instruction for which he has paid; but rather in the situation that, having obtained a much desired position, he is in debt to his environment, and that his advancement or continuation in the desired position depends upon the degree to which he exerts successfully his best energies in open competition with other young men who are pressing toward the same goal.

That the period of greatest energy in creative work is a limited one, no one would deny. At the most, different persons may hold different opinions as to the "normal" duration of that period. Any educational system which unnecessarily robs the potentially creative mind of a single year of that precious time is an unpardonable one; and if the years lost to the individual are stolen from those which are the most valuable of all in the development of the creative powers, the offense is doubly unpardonable. I do not intend to imply that a man cannot perform as good creative work at sixty as he can at twenty-five. There are many types of investigative work which, because of his accumulated experience, he may do much better. But I do believe that the man who starts at the beginning of his twenties to form the habits of independent thought and work has a far greater chance of success, and a far greater chance of developing fully all of his potentialities, than has the man who does not begin to try his wings until he is thirty, when the long years during which curiosity has been aroused again and again but each time allowed to sink passively into indifference, have begun to dull the bright edge of nascent enthusiasm. Even if it were merely a question of experience it is clear that the former individual, thrown upon the world in his early twenties, would possess a rich experience at the time when the latter is only beginning independent work as a novice. Furthermore, the latter is in a position in which he has not only to begin the formation of the desirable habits of mind which are necessary for his success, but has also to break away from the undesirable habits of intellectual dependency which long years of schooling have put upon him. I have known more than one highly intelligent and capable young man, with active interest and critical mind, who has earnestly desired to devote himself to investigation but who has, after a few years, turned to the practice of medicine because he found himself incapable of sustained, independent intellectual effort when he came into possession of the leisure necessary for

investigative work. It is easy to say, of course, that these were men who had no talent for investigation and that those who have will inevitably develop it, regardless of external circumstances. The geniuses will do so, undoubtedly; but that excellent material may be and is being destroyed by a too long period of intellectual dependency I have no doubt whatever.

If there arises at this point the question as to whether a young man in his twenties can really attain a maturity of thought sufficient to enable him to assume independent responsibility in practice, or in teaching and investigation, I believe that there are only two possible answers: either that he can, or else that the quality of the youth of Western civilization has suffered a rapid and serious deterioration. For anyone of the present day who turns through the pages of the history of medicine there is always astonishment at the early age at which most of the men recorded had performed outstanding achievements. It was no rare phenomenon, even so recently as in the past century, to find young men between twenty-five and thirty years of age heading departments, with important scientific achievements and the successful performance of academic responsibilities already behind them. To mention only a few familiar names, (and I should like to stress the fact that many far less prominent men could be cited as well) there was Helmholtz, who was professor of physiology at Koenigsberg at twenty-eight; Heidenhain, professor of histology and physiology at Breslau at twenty-five; Virchow, professor of pathological anatomy at Würzburg at twenty-eight; and, on the clinical side, Nothnagel, professor of medicine and head of the polyclinic at Freiburg at thirty-one; Billroth, professor of surgery and director of the surgical clinic at Zurich at thirty-one; and his pupil Czerny, professor of surgery and director of the surgical clinic at Freiburg at twenty-nine. Indeed, not a few of the men of the last century and before were occupying highly responsible positions in great universities on the basis of their achievements in science, at an age at which the irresponsible American youth of today has hardly shed his coon-skin coat and college yells, and most of them were well on their independent way to renown at the age at which the American medical student is still sitting passively upon the benches of the lecture-room.

I do not pretend to assume that geniuses would be produced imme-

diately if only we were to begin to graduate medical students at a younger age. But I do believe that the process of lengthening the period of passive study has been given a fair enough and a long enough trial to warrant our pausing to take stock of its results. In such an inventory we may properly enquire into the value of the reasons which are offered in justification of the lengthened period of education, and into the value of the product of the present system as compared with the product of that of previous years during which the period of education was shorter, and in which a larger number of the enthusiastic and energetic years of the twenties were available for the beginning of the high adventure of shaping a career.

V

As to the reasons which are supposed to justify the lengthening of the period of schooling, the usual ones are, first, that there is so much more to teach today than formerly, and second that we should try to give the youth as thorough a cultural and professional education as possible, with the idea that the better prepared they are the better will be their chance to live a full and valuable life. Those who dwell upon the idea that there is so much more which has to be learned by the student of today often appear to believe that educators in the past simply refused to teach anything at all about matters which they did not really understand. This, of course, was not the case, as the slightest enquiry into the history of the teaching of any subject in medicine will disclose. Indeed, we ourselves, when we cannot teach the final truth of a matter, proceed after a confession of ignorance to place before the student at least the current theoretical explanations rather than to say merely "we do not know," and there to let the matter rest; and all too frequently we strongly suspect the while that, when the truth is finally known, it will probably be far simpler than the complicated theories which we have to place before the student of today. It must be remembered that in many, many of the instances of what we regard as new additions to knowledge, that which we now teach merely replaced something else which was formerly taught about the same matter. Not at all infrequently a large mass of new facts pertaining to a subject leads not to a larger body of information which the modern student must master, but actually to our ability to place the

subject before the student in a far more concise and simple manner than the theoretical dogmas of a previous age permitted. As a random illustration of this point one might compare the amount of material in Samuel Gross' enormous, closely printed, two-volume textbook of pathology ("The *Elements* of Pathological Anatomy") which had to be studied by students in this country in 1839, with that in the last edition of MacCallum's smaller, single volume on the same subject, which is used by the student of today. In spite of the fact that during the ninety years which have passed between the publication of these two textbooks hardly any subject in medicine has undergone so profound a modification or has acquired so great a number of new facts (microscopic pathology did not exist for Samuel Gross), the standard student's textbook of today on this subject is less than half as voluminous as that of ninety years ago. The point that I wish to make is merely that it is a mistake to assume that each new discovery results in an addition to the total *quantity* which the student has to learn. Most frequently it is merely the quality of what the student has to learn which is affected.

Those who feel that the student has so much more to learn today might also with profit examine the required work of the medical student in Germany just *before* the period of enormous expansion of knowledge which began about 1850. In Bavaria in 1843 (and it was very much the same in the remainder of what is now Germany) the aspirant to a medical degree was required to spend two preliminary years in university work, during which time zoölogy, botany, mineralogy, chemistry and physics had to be studied; and this had to be followed by three years in medical school, ending in examinations which were, however, of a practical nature only in dissection and descriptive anatomy. But after these three years it was necessary to spend two more years in practical clinical work in the medical school (the so-called "Biennium practicum") after which, in order to obtain his doctor's degree the candidate had (1) to submit the case histories of at least three medical and three surgical cases which he had treated, and of three obstetrical cases in which he had assisted; (2) to pass practical examinations which included bandaging, the performance of three surgical operations on the cadaver, and the carrying out of three obstetrical operations on the mannikin; (3) to pass oral examinations in

the following subjects: anatomy, physiology, pharmacology, pharmacy, general pathology, the special pathology and therapy of internal diseases, surgery, obstetrics, veterinary medicine, legal medicine and public health; (4) to pass written examinations in the above subjects; (5) to submit an acceptable dissertation and to defend the theses which it embodied.[4] Thus, in Germany nearly a century ago there was a strict requirement of seven years of university study for the attainment of the degree of doctor of medicine, and it is safe to say that the student of that day had as much with which he might occupy his study hours as has the student of today. The face of the material which had to be learned at that time, however, was very different indeed. It is interesting and pertinent to note that fifteen years later, in spite of the rapid increase in knowledge (during this period of time, among other fundamental advances, the sciences of histology and cellular pathology were born, and Helmholtz' invention of the ophthalmoscope had opened up a vast new field in ophthalmology) the period of schooling was not lengthened because there was then "so much more to be learned." On the contrary, it was *shortened* by one year, a re-arrangement of time providing for the completion of the work in the preliminary sciences in one year instead of two, the extension of the "theoretical" medical school work to four years instead of three, and the reduction of the "Biennium practicum" from two years to one. And yet examinations became even more rigid; to the above mentioned ones there were added practical examinations in medicine, surgery, ophthalmology and obstetrics, requiring the candidate to undertake satisfactorily for eight days the management of one ophthalmological, two medical and two surgical cases, to demonstrate his ability to examine properly two obstetrical cases, and to assist properly at two deliveries. It is clear from all this that in the "dark and ignorant times of a hundred years ago" the medical students had their hands quite as full as have those of today; and while it is true that new sciences, such as

[4] These ancient requirements, as well as the more modern ones which I have already cited, should be contemplated by those who idealistically interpret *Lernfreiheit* to mean freedom of the student to select his own course of study; and a hundred years and more ago the true spirit of *Lernfreiheit* was as much prized in Germany as it is today (cf. Fichte's Rectorate address on "Akademische Freiheit" before the Freidrich-Wilhelms University in Berlin in 1811).

bacteriology and immunology have appeared, it is also true that the present-day medical student is little troubled by certain subjects which were required in the medical schools of a century ago, e.g., veterinary medicine, legal medicine and public health.

In comparison with this requirement of six years in Germany during the period in which many of the outstanding figures of the last century were being trained, today at Johns Hopkins an average minimum of eight years of university and medical school work is required, and the preliminary common school and high school requirements bring it about that the American student is several years older in years (but rather several years younger in mentality!) than was the German student on his entry to the undergraduate college—which should be synonymous with the approach to a career, but is all too commonly synonymous with the approach to four years of irresponsible pleasure-making.

VI

Let us now turn for a moment to the second reason commonly offered in justification of the lengthened period of schooling—i.e., that the individual will enjoy a more full and serviceable life if he has been given a thorough cultural and professional education. I should prefer to put it "if he *acquires* a thorough cultural and professional education"; for I believe that all who are seriously interested in educational matters, and who are able to regard dispassionately the effects of the frantic effort to make philosophers out of all of our citizens, are beginning to understand that it is quite impossible to "give" everyone a cultural education regardless of how much time or money or apparatus or teaching effort is put into the matter. I shall not labor this point, for educators the country over have expressed themselves freely enough on the subject to leave no one with the illusion that the undergraduate colleges of the land are actually imparting to the youth an amount of culture which is commensurate with the expenditure of time spent in the college. Five years ago, in a paper read before the Johns Hopkins Medical Research Society, I presented a statistical analysis of what appeared to me to be some of the unfavorable results of the modern system of protracted schooling, together with certain other reasons for hastening the period of independent work which are discussed in the

present paper. As one step toward remedying the situation (besides an arrangement which would shorten the period of passive medical study) I wished to suggest a type of entrance requirement more flexible than the stereotyped insistence that each medical student possess a college degree and, anticipating the objection that four years spent in college are essential in that they impart a cultural background for the professional career, I brought with me the results of written examinations which I had given to the second year class of the medical school for several years. These examinations, which the students attacked with hearty interest, were of the broadest possible character, consisting of fifty questions dealing only with the most outstanding names and events in history, philosophy, literature and the arts, the slightest information about which being all that was required as a satisfactory answer. The purpose of the questions was purely to attempt to detect any cultural interest which had been stimulated to an effective degree in the undergraduate college work. I am thoroughly aware of the limitations of any such quiz-method of determining the content of the human mind, and I mention these examinations only for the reason that, even with due regard for these limitations, the results were overwhelmingly convincing that the amount of cultural information or cultural interest which all except the most occasional students acquire in our present-day colleges is entirely too slight to justify our heedless insistence that more time be spent in college than is necessary for a sound premedical training. Today the realization of the inadequacy of the four collegiate years is so widely recognized, and is so plainly apparent in the multiplication of technical and popular articles on the subject, that it would be superfluous to proceed further to prove the point by statistics or argument. Indeed, as a specific instance of the rapidly spreading consciousness of the wastefulness of the present system and the changing attitude, even among those who prized the system most highly, it is of interest that one of the members of the Medical Research Society, who, five years ago in the discussion following the presentation of the paper to which I have referred above, objected vigorously even to the idea of abolishing the baccalaureate requirement on the basis of his conviction that a four years course in college really provided a sound foundation for culture, has since, having become dean of a newly-founded medical school, turned to the belief that it does not and

that valuable time is being wasted by our present scheme of protracted education; and he has wholeheartedly adopted both the idea of abolishing the baccalaureate requirement and of shortening the medical school course. The wonder is that any medical school, in the face of the redundant evidence, continues to require that prospective students must barter four years of their youth for the meaningless bachelor's degree. Especially, perhaps, may wonder arise in the case of the Johns Hopkins Medical School, since the University of which it forms a part has seriously considered the idea of abandoning the field of undergraduate education—and this, one may infer, not because it regarded as highly successful the modern wholesale methods used in the effort to impart to masses of undergraduate students an appreciation of higher culture.

VII

So much for the value of the reasons commonly offered in justification of the requirement of a college degree as a prerequisite to the study of medicine. What now do we find on an examination of the end product of our system of protracted education? Are the individuals who have remained longer in the passive condition of pupils in any sense a better product than those of the past century who completed their medical education in their early twenties? Certainly, as far general culture is concerned they are not. Indeed, there is no question but that, by and large, they are distinctly inferior in this direction, as any study of the lives and writings of the men of the past century will immediately disclose. We need not pause at length to contrast the narrow interests characteristic of modern minds and personalities with the broad interests of the gentlemen of the old school. As those splendidly developed minds, formerly so plentiful, to which a broad culture was a matter of course, disappear from among us one by one, there are always heard regretful comments on the passing of a wonderful type of human development with little on the horizon which gives promise of being able to replace it. It is somewhat as though one were witnessing the gradual extinction of a higher race by an invasion of barbarians. It is a very great mistake to assume, as many do, that the incurious minds of young men in their thirties will spontaneously blossom into minds of wide and deep cultural interests at the approach of

old age. Breadth of interest must be a habit of youth or, with the very rarest exceptions, it will never appear at all; and unless it be cultivated actively in youth it scarcely ever attains any really effective degree of development. Our present system of education, for all its greater length, not only fails to "give" breadth of cultural interest to the youth, but (a more serious indictment) the atmosphere of the modern university actually tends to inhibit the free development of cultural interests; and this, partly at least, because the colleges are overfilled with students who have not the slightest interest in or desire for intellectual development. The presence of such students in large numbers dilutes too greatly the smaller group who are of a better type, and exerts an unwholesome influence not only upon the character of the teaching, but directly upon the smaller group of impressionable youths by establishing as the ruling forces of student life ideals, if they may be so called, which are not at all the ideals of intellectual development.[5]

[5] The evil effects of a somewhat similar situation may, indeed, be observed on many sides today in the faculties of our medical schools. An abundance of available money has led to the widespread construction of large buildings, each containing many more rooms than the former housing of the particular departments contained. Ordinarily, the excuse offered for building beyond the actual need is that provision is being made for expansion in the future while funds are available. However, in actual practice it is almost unknown that the rooms which are built "for the future" are resolutely sealed up until future growth and the appearance of greater numbers of competent men demand their use. Most heads of departments seem to abhor the vacuum of unoccupied rooms and laboratories, and they straightway fill them up with workers. It has for some time been apparent to everyone that it is impossible to fill them all with workers of high excellence, but no matter—they are filled nevertheless; and the baneful process of dilution begins to operate, with results which are, perhaps, more far-reaching than is ordinarily suspected. When inferior workers in unnecessarily large numbers become an integral part of the faculty of a medical school the general level of the quality of the teaching is lowered, and the student's opinion of what constitutes fitness for a university career is also lowered; but in addition, the presence of such men in numbers rarely fails to lower to some degree the standards and ideals of the departments which harbor them. Competition within the department becomes less keen because there are more positions available than there are good men to fill them. The investigative work which is carried out in a forced way by the academic jobholders leads to the publication of many papers which have, to say the least, a doubtful value—papers of a type which would be less likely to emanate from a department with a smaller staff of men carefully chosen purely on the basis of their fitness or promise. Fur-

From the cultural standpoint, it is certainly far from clear that our system of prolonged schooling is worth the time lost by it. As to the final question whether the system tends at least to produce in medicine

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thermore, most of the members of departments which are overstaffed with mediocre men, influenced unquestionably by the lack of hard competition (which, in spite of visionary opinions to the contrary, will always remain a powerful stimulus to the best development of youth) pursue a rather *laisses-faire* course as far as the attempt at mastery of their subject is concerned. It is, indeed, an astonishing thing to observe how many young men in academic medicine today tend to drift along thoughtlessly as though they were in perfect and permanent security, and as though the careless passing of their young years were of no serious consequence to their future careers. I cannot escape the conviction that the superabundance of open places resulting from over-expansion of departments is largely responsible for this, first by bringing into the Faculties many who are downright unfit for an academic career, and finally by removing most of the spur of that type of competition which makes excellence the prime requisite of survival. A man must be poor material indeed to-day if he cannot find a place upon the staff of a department in some good university. There are laboratories which have to be filled; there are endowments for research which have to be spent. Few would dream, I believe, of constructing one building larger than another, all containing many rooms furnished with easels and paint-boxes and pianos, with the idea of then casting about to find young men to place in all of the many rooms in the expectation that a continuous stream of fine, creative works of art would be produced in that manner. And yet investigative work in science is creative work no less than is painting or musical composition. The tacit assumption that a competent investigator can readily be found for every room in every projected new building is as misguided as a similar assumption in regard to creative artists would be, and becomes productive of a mass of hack-work as surely in the one case as it would in the other. Such an attitude on the part of a university merely tends to vulgarize an ideal which the university should strive to exalt. Years ago, Huxley foresaw many of the dangers of the over-endowment of research which today are only beginning to be observed. At the formal opening of the Johns Hopkins University, in 1876, he remarked: "A great warrior is said to have made a great desert and called it peace. Administrators of educational funds have sometimes made a palace and called it a university." And, in another place: "You know that among the Bees it depends upon the kind of cell in which the egg is deposited, and the quantity and quality of food which is supplied to the grub, whether it shall turn out a busy little worker or a big, idle queen. And, in the human hive, the cells of the endowed larvae are always tending to enlarge, and their food to improve, until we get queens, beautiful to behold, but which gather no honey and build no comb."

In observing the effects of the over-expansion of certain departments in various medical schools there sometimes come to mind the words which Galileo, in his

men who are greater masters of their subjects and more able investigators and teachers than did the system in the past century which permitted the earlier graduation of the student, the slightest acquaintance with the history of medicine during the past hundred years is, of course, sufficient to answer that question in the negative. Thus, the reasons ordinarily given to justify the present system are not really valid ones, nor is the product, judged from the standpoint of intellectual excellence, an improvement over the product of a less extended period of schooling.

VIII

In the above discussion I have sought to emphasize certain dangers inherent in an over-long period of schooling. It is now proper to enquire what can be done to protect from those dangers many of the young men who wish to study medicine. From what I have said it should be evident that I realize that reform in our present system should begin in the preliminary education—extending, indeed, into the primary schools themselves. Perhaps no truly satisfying reform will ever be possible unless it have its ultimate roots in the gradual development of a cultural tradition in the individual homes of the people—a development which depends more upon the type of the schoolmasters to whom the young are exposed than upon the arrangement of the subjects which have to be learned. While we must hope and even strive for the accomplishment of these fundamental reforms, it lies more within our power to improve the conditions which affect directly our own branch of the field of education. In any immediate effort to prevent

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"Dialogues Concerning Two New Sciences," speaks through the person of Salviati: "The larger the machine the greater its weakness . . . . for we can demonstrate by geometry that the larger machine is not proportionally stronger than the small."

For those who have given their energy, time and forethought to the matter of obtaining the funds which have brought about the notable improvement in the material resources of the medical schools there can be only unstinted praise and appreciation, for their efforts have served to ensure a needed security for the proper development of the schools. It becomes, however, the direct responsibility and it should be the earnest and watchful concern, of the Faculties themselves that newly-acquired resources do not exert an unhealthy influence through being used in a *nouveau-riche* manner in which unbalanced attention is given to externals.

an undue waste of valuable years there are only two points at which we may with profit consider the advisability of altering our present scheme. The first of these lies in the period of premedical training; the second in the required work in the medical school.

In regard to the premedical requirement it is, I realize, exceedingly difficult to reach the conclusion that any shortening of the four years' time spent in undergraduate college work can be productive of good. It is so difficult to dissociate, in our own thought, our ideal of what the baccalaureate training should be from that which it actually is in our modern universities; and when we try to think of saving a year or two from this period of education we rather reflexly react against the idea, and tend to conclude that that would mean a retrogression and the forsaking of an ideal. A balanced judgment can be reached, however, only by weighing, dispassionately, the actual gain derived against the actual loss in time expended. Personally, under conditions of education as they exist today, I feel strongly in favor of a careful consideration of arrangements which would shorten the period of passive study —which would conserve, instead of expend injudiciously, each of those years of the twenties which are so very important in the process of the development of intellectual independency. I do not for a moment mean to suggest that the occasional student who really finds in the college an inspiration or an opportunity to satisfy his intellectual curiosity should be discouraged in the slightest degree from remaining there as long as he might feel it to be profitable. It is obvious, furthermore, that the preliminary, premedical requirement in languages and in the fundamental sciences must be rigidly maintained. But with these fundamental and definable requirements properly satisfied, I should prefer to *permit* the promising student who desired to do so to plunge into his medical work forthwith, rather than to *force* him, willy nilly, to dawdle away two extra years on the undergraduate campus as it exists today: and this for the reason that in addition to the virtue of the years saved, I feel strongly that, for the majority of young men, the atmosphere of the medical school is far more stimulating even toward cultural development than is the atmosphere of the undergraduate campus. It is an interesting, if disheartening, commentary that the occasional second year medical students who displayed an

unusual degree of cultural attainment in the examinations to which I have referred above, when questioned personally as to the source of their greater breadth of interest declared unhesitatingly, and without exception, that both their stimulus and their best efforts toward the acquisition of what information they possessed lay outside of the undergraduate courses which they had attended in pursuit of their bachelor's degree. Perhaps these were only exceptional cases; but we must fairly face the undeniable fact that a baccalaureate degree from an American university is a sadly deficient guarantee of the acquisition of even the elements of an effective cultural curiosity. I think that few would fail to agree that the average English medical graduate is, to say the least, no less cultured an individual than is the average American medical graduate; and yet less than ten per cent of all medical students in England possess academic degrees. It is hardly in an extra year or two in college that we must seek for the secret of the acquisition of culture.

I realize that the question of permitting entrance to the medical school before the attainment of a baccalaureate degree is a serious one, requiring careful thought and study. But I also believe that the blanket requirement of such a degree is also a matter which can profitably be re-examined in the light of existing conditions. In forcing such a requirement upon the prospective student of medicine we should at least be perfectly sure that in fact, not in theory, the majority will gain more in culture than they will loose in enthusiastic years of youth which might be spent under conditions more stimulating to the intellect. I do not pretend, in this discussion, to have settled the question in any way. I merely submit that it is a question worthy of study; and I should like to point out particularly that in the other departments of the Johns Hopkins University a frank recognition of the inadequacy and wastefulness of the stereotyped modern college course of four years has led to the recent abolition of the requirement of the bachelor's degree for entrance to the graduate schools, even in the case of the humanities. Under the new plan, after the completion of fundamental required work, which occupies about two years in the undergraduate college, the student is at once at liberty to enter any graduate department and to specialize toward his degree in the work of that department. Surely, where the humanities lead in matters pertaining to general cultural development the medical school need not fear to follow.

IX

Whatever may be the advisability of an entrance requirement more adaptable than the rubber stamp of a college degree, it is possible, I believe, to arrange the required work in the medical school in such a manner that the period of passive absorption of knowledge may be shortened by one year without the sacrifice of any work required at the present time, without introducing any such undesirable expedients as summer sessions, and without overcrowding the student's time. A modified form of curriculum, possessing certain distinct advantages in relation to the ideas expressed in the preceding parts of this paper, will be outlined here, not because I believe it to represent a final and completely Utopian solution, but rather for the reason that during a period of earnest experimentation, criticism of existing methods should at least rest upon a definable possibility of improvement.

One of the glaring defects in medical education which served to stimulate the present widespread effort to improve the curriculum was the overcrowding of the student's time with a large number of required hours devoted to brief, expository elective courses, which resulted in a somewhat frantic attempt on the part of the student to obtain a smattering of information about every conceivable sort of special division of the art and science of medicine. It became evident at last that this flitting from one specialty to another was not the best method of utilizing the student's time, or of acquiring a satisfactory amount of useful, correlated information. Too much time was being devoted to a type of tabloid education quite on a level with that provided by those popular Outlines of Knowledge which promise anxious and unprepared individuals relief from the feeling of inferiority which might otherwise overtake them if someone should chance, unexpectedly, to mention at dinner a philosopher, a Greek courtesan or a law of thermodynamics. In short, it was realized that it was quite impossible to impart to each student a satisfactory amount of information pertaining to a multitude of special branches of medicine; and that it was of first importance to plan a sound, fundamental course of study in basic preclinical and clinical subjects providing, in addition, time and opportunity for the student to supplement this basic training with elective work which he would choose seriously and

freely with the idea of strengthening his knowledge of things pertaining to the branch of medicine toward which his inclination lay. The manner in which each of our various medical schools is at present attempting to re-shape its curriculum for the better advantage of the student is of considerable interest, for in each case the modifications have the nature of an experiment in education, and the results when finally analyzed will provide a tested basis for a better approach to a sound system.

The first problems which are encountered in the attempt to correct the errors of the overcrowded curriculum are, obviously, the question of the nature and the extent of the required work, and the manner of treatment of elective courses. Several years ago at the Johns Hopkins Medical School the curriculum was completely revised in a manner which has already yielded interesting and instructive information. Faced with the unsound pedagogical principles inherent in a too rigid and didactic course on the one hand, and in a curriculum overcrowded with required electives on the other, the curriculum committee decided to make a rather clean sweep by cutting down the required work to an irreducible minimum, leaving time equivalent to about two years out of the four as "free time" which the student might use as he chose without any spur of university requirement or credit. Indeed, even in the required work all grading of students was abolished, other than the designation "passed" or "failed." The student was told that in his abundant "free time" he might read and study at his leisure, he might engage in research in any of the laboratories, he might enroll in any available elective courses which appealed to him, he might travel abroad, or widen his outlook by study in another medical school. In the most generous interpretation of the term the student was given all of the real and imagined opportunities implied by the term "Lernfreiheit." I think that there is no one connected with the teaching staff who does not feel that the drastic action of the curriculum committee was a step of the utmost importance. There are some, indeed, who feel that, as it stands now, the curriculum is in essence an excellent one. It is the opinion of many, however, that the chief virtue of the change has been the fact that it cleared away effectively the tangled thickets of required electives and so left a free space upon which to build properly afresh.

The main features of the curriculum as it stands which appear to me to be worth considering with a view to modification may be inferred from the discussions in the previous parts of this paper. Specifically, I believe (1) that the students are given free time in too great quantity before they are able to use it wisely; (2) that, therefore, under the present freedom, the students, in their helplessness, are turning back of their own accord to the condition which the change sought to eradicate, i.e., the filling up of their large amount of free time with this and that expository elective course;[6] (3) that the elective courses available for the students are not sufficiently important in proportion to the amount of free time allowed for their pursuit; (4) that it is a question under any circumstances whether the required work in the general principles of a course should be cut to a bare minimum simply in order to permit students to spend the time saved in an elective course on a restricted corner of the subject. This question has two important aspects: in the first place, it must be clear that the shortening of the general course in order to provide time

[6] Under the present system the capable students show themselves hardly more able than the poorer ones to choose electives wisely and to avoid the vice of flitting from one brief lecture "course" to another. The Dean's office has kindly placed at my disposal ten schedules of those considered by the office as representing ten of the best students in the fourth year class. I have taken five of these schedules at random for analysis. The number of courses elected during the four years by these excellent students was 30, 37, 39, 40, and 48 respectively. In each instance the overwhelming majority of the courses elected were brief, expository ones. I must confess that I am able to see very little, if any, difference in the manner in which these students utilized their free time as compared with the schedules of students in the days of the over-filled curriculum which the present plan sought to correct. It may be instructive to list here, as an example, the elective courses with which one of these five outstanding students occupied the free time given to him.

First year		*Second year*	
Electives	*Hours*	*Electives*	*Hours*
*Histology Lecture	16	Bacteriology	32
*Anatomy Lecture	16	*Gen'l. Physiol. Lecture	8
*Pharmacology Lecture	16	*Pharmacol. Lecture	8
*Physiology Lecture	24	*Physiol. Chem. Lecture	16
Mammalian Physiology	24	*Surgery	16
*Physiol. Chem. Lecture	8	*Tuberculosis	8
Gross Dissection	160	Gross Dissection	48

for the electives deprives the entire class of a more thorough training for the sake of the few who may choose to elect the extra specialized work in that subject; and in the second place, I feel that, even in the case of the student who elects work in that subject, it is unwise to abridge his general training in that subject for the purpose of encouraging him, in his undertrained condition, to specialize in whatever restricted elective courses the passing whim of the instructors may make available. In other words, I believe that a more thorough grounding for each student in the general principles of pathology, for example, is more valuable in the long run than is a hurried general course which must be skimped by the entire class in order to leave free time for an elective course concocted for a few students on, say, the pathological changes occurring in the spleen.

The principles of a curriculum which may be suggested as a modification of the present one for the purpose of eliminating some of the evils which I have discussed in this paper may be briefly stated as follows: (1) The basic required courses would be exactly the same as those

Third year		*Fourth year*	
Electives	*Hours*	*Electives*	*Hours*
Operative Surgery	32	*Neurosurg. Rounds	8
*Gyn. Lecture	24	*Pediatric Lecture	56
*Surgery of Neck	16	*Orthopedic Clinics	16
*Psychiatry	24	*Medical Clinics	32
*Infectious Diseases	24	*Surgical Clinics	16
*Obstetrical Rounds	16	*Clin. Path. Conference	16
Tuberculosis	48	*Psychiatric Rounds	16
*Gyn. Pathology	24	Pediatrics Dispensary	96
Medical Dispensary	32	*Surg. Path. Conference	16
Dermatology	32	*Orthopedic Rounds	8
Gyn. Dispensary	48	Syphilis Dispensary	48
*Obst. Pathology	24	Surgical Laboratory	64
*Medical Rounds	32	*Psychiatric Clinics	16
*Medical Clinics	16	Orthopedic Dispensary	32
Obstetrics	24		
*Surg. Pathology	40		
*Surg. Clinics	16		
*Medical Jurisprudence	8		
G. U. Dispensary	32		
*Abdominal Surgery	16		

* Indicates an expository (non-practical) course.

of the present curriculum. In no instance would any required course be shorter than at present. Indeed, in two important instances the courses would be lengthened. (2) An ample amount of free time would be provided all along the way, but a superfluity at no point. (3) The required work—all that is required under the present curriculum including, it is to be emphasized, an extension, not a reduction, of the time devoted to the required work—would be completed by the end of the third year, and this without any prolongation of the academic year or the sacrifice of any vacation time now provided for. (4) Instead of scattering throughout four years large blocks of free time which the students are unprepared to use wisely, and much of which is at present spent in non-practical, expository elective courses, an entire year of free time would be conserved, over and above the reasonable amount given all along the way, and this year of free time would constitute the fourth year of the medical school. Instead of spending it in expository elective courses, however, the student would serve as an "apprentice" in *practical* work in one or several departments, preferably with a minimum of four months service in any one department.

The virtues of such a plan are as follows: sound, thorough, general courses in the required subjects would be presented to the student in the proper order. The arrangement of the courses (Tables I, II and III) may be regarded as purely tentative. Any manner of rearrangement is perfectly possible. The essential point is that there is ample time in the first three years to complete all of the courses required at present. Each of the courses in the proposed curriculum is of exactly the same length as in the present one except physiology which is increased from the present 168 hours to 344 hours, and physiological chemistry from the present 152 hours to 176 hours. These increases are, of course, merely suggestions. Other courses could be lengthened if desired.

As for free time, in the first year in the medical school the student should be expected to throw himself into his new work with an enthusiasm and interestedness which would render a large amount of unoccupied free time thoroughly unnecessary and undesirable. Certainly, I believe that it is a waste to set aside free time in the first half of the first year with the idea of allowing the completely unoriented

student to select elective courses with which to fill it. It will be seen from a glance at the curriculum which is set forth here that an overgenerous amount of free time is provided, and that it is arranged in such a fashion that more becomes available as the student advances and becomes better able to use it profitably. In considering the amount of free time provided by this scheme it should be remembered that the time left unassigned here is actually free time. It can be filled with no electives of any sort, for no electives are offered. The time is left purely at the disposal of the student for study, for research, for cultural pursuits, for play if he wishes. Viewed in this light, the amount of free time embodied in this proposed curriculum will be realized to be exceptionally generous, for these free periods are not to be filled up with any courses of any sort, whether elective or required.

At the end of the third year, the student will have completed every course which is now required in the medical school, and some of the courses will have been more extended than they are at present; none more brief. During the three years the curriculum will have guided the student in an orderly way through the fundamental courses of the school. Now, at the end of the third year, having studied and had practical experience in each of the main preclinical and clinical divisions of medicine, the student will be in a better position to decide what elective training will be most helpful to his future, for he will be in a better position to form an opinion as to what branch of medicine has appealed to him most. And, instead of having had his free time dissipated here and there throughout four years (most of it, indeed, being lost before he had really had an opportunity to gain an adequate idea of the major clinical subjects) he now has an entire free year before him, the proper use of which will be required before he is granted his degree. But, having completed all of the required work of the medical school, he is in a position to be useful to whatever department he chooses to work in, and to use this year of free time in a very practical way rather than in taking expository "courses." The fourth year, therefore, might well be termed an "apprentice year," for each student would literally be required to apprentice himself during this year in one or two departments of his own choosing and he would, giving his full time to those departments, undertake practical work and assume definite responsibility. The student, for example, who felt that he

wished to enter clinical medicine as a career but who appreciated the value of a year spent in pathology as an aid to the diagnosis and interpretation of disease, would spend his apprentice year in the department of pathology, thereby securing this year of preparatory experience before graduating from the medical school, instead of having to spend an extra year in addition to the four school years, as is now the case. In the department of pathology the apprentice would occupy a position comparable to that held at present by the graduate voluntary assistants. He would have the responsibility of performing autopsies in rotation with the members of the staff, of preparing the protocols and of working up the cases properly. He would attend and take part in the staff conferences, and assist in a subordinate way in the teaching; and he would be given facilities and encouragement to prosecute by investigation any problem which might attract his curiosity. A year spent in this way would surely be of more solid worth to the student than is the present system of flitting from one brief elective course to another before being prepared to appreciate any of them from the vantage point of the graduate student; and the various departments, which now feel that in their elective courses they have to deal with raw and unfinished students, would be just as willing to offer the opportunity of responsibility, as a voluntary assistant, to the student in his apprentice year as to the graduate of the medical school, for the apprentice would have completed all of the present required work of the school. I have offered medicine and pathology as an example of the manner in which the student could literally save an entire year in his training under this scheme, but it is clear that no matter what the decision of the student might be regarding his future, the same virtues of the plan would apply. Thus a prospective surgeon might choose to spend his apprentice year in anatomy, a prospective physiologist in biochemistry, a prospective psychiatrist in neurology; migration to another medical school in this country or abroad for an entire year in the capacity of voluntary assistant would be perfectly feasible for the student who had completed all of the required work of the school, and the student so prepared would be far better able to profit from such migration than is the present fourth year student who has not yet completed the major part of his clinical training. Furthermore, being in a position to be of distinct use in the department of the school

to which he migrated, his opportunities as a voluntary assistant there would be distinctly superior to his present opportunities as an uninitiated student. Such details as the most satisfactory length of time for service as an apprentice in various subjects could be decided by each department. In my own opinion, however, not less than half of the apprentice year should be spent in any one chosen department, if the training is to be expected to be of real and lasting value; and in the major subjects perhaps not less than the full year. I believe that such an apprentice year would, in most departments, be vastly superior as regards the character of the training received than is the present system under which most of the elective courses are non-practical. It would, besides, give the student a better chance to decide how to use his elective time wisely and would, by the nature of his position as a voluntary assistant in the department, end his period of passive absorption of knowledge and begin his period of responsibility and active acquisition of knowledge an entire year sooner than under the present system. Since it would be possible for only a limited number of students to be accepted as apprentices in each subject, there would be an important element of competition in the gaining and, indeed, in the holding of the desired positions, for no student who neglected the work of the department in which he had elected to assist should be retained as an apprentice in that department. Furthermore, since the work of the fourth year would be of a purely practical type carried out in close contact with the staff of the department, it would be salutary for the student to realize that his actual capabilities for independent work would be more clearly exposed to the Faculty than by any system of classroom work; and that his opportunities for appointment to an interneship on graduation would be correspondingly affected.

The question may be asked "Can this curriculum and this apprentice system be made to work from the standpoint of mechanical administration?" The major mechanical details are embodied in the tables illustrating the curriculum where such matters as hours, order of course, etc., are worked out perfectly smoothly.[7] It is, of course,

[7] I am indebted to Dean Alan M. Chesney for checking over the mechanical workability of this curriculum, and for helpful suggestions regarding the best distribution of some of the dispensary courses from the standpoint of the facilities of this medical school in which almost all of the dispensaries operate in the morning only. Dr. Chesney has pointed out

entirely possible to change many of these details without altering the general ideas embodied. I would like to emphasize that this suggested curriculum represents nothing more or less than a redistribution of the free time created by the curriculum committee several years ago. As for the apprentice year, it is obvious, of course, that the whole or even the major part of the class cannot elect to serve as apprentices in any one subject. Each department must decide how many students can be accommodated on such a basis and choose from among the applicants those which it desires. Some of those, therefore, who might wish to work in pathology, for example, would be unable to do so if the number of applicants surpassed the number of available places. These men might go to the department of pathology in another school as voluntary assistants if they wished, or they might decide upon a different subject in which to spend their time. It is to be remembered that this difficulty of providing a place in every department for every student who wishes to work there in his free time exists in full force under the present elective system; for at present, and it has always been so, the number of men admitted to any elective course involving practical work is strictly limited by the mechanical facilities. Under the apprentice system this limitation will obviously exist exactly as it does under the present system; but it may be pointed out that, from information supplied by the various departments as to the number of apprentices who could be accommodated, it is clear that the total number of places which would be available for students of the apprentice type is far in excess of the number of students in any one class in the medical school. It is also obvious that, since most of the dispensary electives in this medical school occupy at present only half of the day, the unoccupied half of the day could be spent in a different subject if the student chose. In schools in which the dispensaries operate in both morning and afternoon the opportunities for students to apprentice themselves in clinical work would, of course, be doubled.

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to me that the only mechanical difficulty in the suggested schedule as it stands is a conflict between obstetrics and medical and surgical ward rounds—an inadvertent conflict which could easily be overcome by a slight rearrangement and by the utilization of a small fraction of the rather excessive free time in the third quarter of the second year. Throughout this schedule it is provided that the student groups in each course would be exactly the same size as they are under the present curriculum, and that no additional instructors would be needed.

In conclusion, I realize that in human affairs it is quite impossible to work out any ideal system in full confidence that, if put into operation, that system will reform the vices of the existing order without introducing unforeseen difficulties which may be worse than those which one is seeking to displace. However, in the long run one usually profits to some degree by undertaking experiments which contain a large element of reasonableness, even if, in the course of time, profound changes have to be made, and steps taken retraced. The experiment of prolonging the period of education has been an instructive one; the experiment of giving excessive freedom to the student of medicine has also been an instructive one; without question, both have enlightened us in numerous ways. I believe, however, that the period of passive reception of knowledge has been too greatly prolonged, and that the freedom given in various medical schools has been both excessive and badly distributed. The plan suggested here seeks to promote the earlier development of intellectual independence, and to combine the best elements of an ordered curriculum with the best use of a liberal amount of free time; and all of this from the standpoint of attempting to fulfill in the best way the three fundamental purposes of a good curriculum which were outlined in the first part of this paper.

TABLE I

Suggested Curriculum, First Year

First Quarter

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
9–10	Anatomy	Anatomy	Anatomy	Anatomy	Anatomy	Anatomy
10–11	"	"	"	"	"	"
11–12	"	"	"	"	"	"
12–1	"	"	"	"	"	Physiological Chemistry
2–3	Histology Neurology	Histology Neurology	Histology Neurology	Histology Neurology	Histology Neurology	**FREE**
3–4	"	"	"	"	"	"
4–5	"	"	"	"	"	"

Second Quarter

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
9–10	Physiological Chemistry	Anatomy	Physiological Chemistry	Anatomy	Physiological Chemistry	Anatomy
10–11	"	"	"	"	"	"
11–12	"	"	"	"	"	"
12–1	"	Physiology Lecture	"	Physiology Lecture	"	Physiology Lecture
2–3	"	Histology Neurology	"	Histology Neurology	"	**FREE**
3–4	"	"	"	"	"	"
4–5	"	"	"	"	"	"

Third Quarter

9–10	Physiology	Bacteriology	Physiology	Bacteriology	Physiology	Bacteriology
10–11	"	"	"	"	"	"
11–12	"	"	"	"	"	"
12–1	"	"	"	"	Pharmacology Lecture	"
2–3	"	**FREE**	"	Psychobiology	Physiology	**FREE**
3–4	"	"	"	"	"	"
4–5	"	"	"	**FREE**	"	"

Fourth Quarter

9–10	Pharmacology Lecture	Pharmacology Lecture	Physiology	Pharmacology Lecture	Physiology	**FREE**
10–11	Physiology	Pharmacology Laboratory (1/2 Class)	"	Pharmacology Laboratory (1/2 Class)	"	"
11–12	"	"	"	"	"	"
12–1	"	"	"	"	"	"
2–3	"	**FREE**	"	**FREE**	"	**FREE**
3–4	"	"	"	"	"	"
4–5	"	"	"	"	"	"

TABLE II

Suggested Curriculum, Second Year

First Quarter

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
9–10	Pathology	Clinical Microscopy	Pathology	Clinical Microscopy	Pathology	Clinical Microscopy
10–11	"	"	"	"	"	"
11–12	"	"	"	"	"	"
12–1	"	"	"	"	"	"
2–3	"	**FREE**	"	**FREE**	"	**FREE**
3–4	"	"	"	"	"	"
4–5	"	"	"	"	"	"

Second Quarter

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
9–10	Pathology	Normal Physical Diagnosis	Neurology Diagnosis	Diagnostic Methods	Diagnostic Methods	Normal Physical Diagnosis
10–11	"	"	Pathology	"	Pathology	"
11–12	"	"	"	"	"	"
12–1	"	"	"	"	"	"
2–3	"	Psychiatry	"	**FREE**	"	**FREE**
3–4	"	"	"	"	"	"
4–5	"	**FREE**	"	"	"	"

Third Quarter

9–10	Pathology	Pathology	Medicine	Medicine	Medicine	Medicine
10–11	Physical Diagnosis A	**FREE**	**FREE**	Physical Diagnosis A	**FREE**	**FREE**
11–12	"	"	"	"	"	"
12–1	"	"	"	"	"	"
2–3	Pathology	Hygiene	Pathology	Hygiene	Pathology	Hygiene
3–4	"	**FREE**	"	**FREE**	"	**FREE**
4–5	"	"	"	"	"	"

Fourth Quarter

9–10	Therapeutics	Hygiene	Pediatrics	Hygiene	Pediatrics	Hygiene
10–11	Psychiatry Dispensary 1/2 A	Neurology Dispensary 1/2 A	Neurology Dispensary 1/2 A	**FREE**	Psychiatry Dispensary 1/2 A	**FREE**
11–12	"	"	"	"	"	"
12–1	Medicine	Surgery	Ophthalmology	Therapeutics Ophthalmology	Surgery	Medicine
2–3	Laryngology (Groups)	**FREE**	Laryngology (Groups)	**FREE**	**FREE**	**FREE**
3–4	"	"	"	"	"	"
4–5	"	"	"	"	"	"

TABLE III

Suggested Curriculum, Third Year

First Quarter

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
9–10	Obstetrics	Obstetrics Gynecology (Groups)	Obstetrics	Obstetrics Gynecology (Groups)	Obstetrics	Obstetrics
10–11	A Medicine	A Medicine	A Medicine	A Medicine	A Medicine	A Medicine
11–12	"	"	"	"	"	"
12–1	Medical Clinic	Surgical Clinic	Psychiatry Lecture	Neurology Clinic	Surgical Clinic	Medical Clinic
2–3	Medicine	Medicine	Medicine	Medicine	Medicine	FREE
3–4	"	"	"	"	"	"
4–5	"	"	"	"	Medical Zoology	"

Second Quarter

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
9–10	A Medicine	A Medicine	A Medicine	A Medicine	A Medicine	A Medicine
10–11	"	"	"	"	"	"
11–12	"	"	"	"	"	"
12–1	"	"	"	"	"	Pediatrics 11:30–1
2–3	"	"	"	"	"	FREE
3–4	"	"	"	"	"	"
4–5	"	"	"	"	"	"

Third Quarter

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
9–10	Obstetrics	Obstetrics Gynecology (Groups)	Obstetrics	Obstetrics Gynecology (Groups)	Obstetrics	Obstetrics
10–11	A Surgery	A Surgery	A Surgery	A Surgery	A Surgery	A Surgery
11–12	"	"	"	"	"	"
12–1	Medical Clinic	Surgical Clinic	Medical Clinic	Therapeutics	Surgical Clinic	Medical Clinic
2–3	Laryngology (Groups)	FREE	Laryngology (Groups)	FREE	FREE	FREE
3–4	"	"	"	"	"	"
4–5	"	"	"	"	"	"

Fourth Quarter

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
9–10	A Surgery	A Surgery	A Surgery	A Surgery	A Surgery	A Surgery
10–11	"	"	"	"	"	"
11–12	"	"	"	"	"	"
12–1	"	"	"	"	"	Pediatrics 11:30–1
2–3	A Ophthalmology	"	1/2 A Surgery 1/2 A Ophthalmology	1/2 A Surgery 1/2 A Ophthalmology	FREE	FREE
3–4	"	"	"	"	"	"
4–5	Surgical Pathology	"	Surgical Pathology	FREE	"	"

TABLE IV

Group Rotation in Wards and Dispensaries

Second Year	Third Year	
Fourth Quarter	*First Quarter*	*Second Quarter*
A Neurology–Psychiatry Dispensary	A Medical Dispensary	A Medical Wards
B Surgical Dispensary	B Surgical Wards	B Medical Dispensary
C Medical Dispensary	C Medical Wards	C Surgical Dispensary
	Third Quarter	*Fourth Quarter*
	A Surgical Dispensary	A Surgical Wards
	B Neurology–Psychiatry Dispensary	B Medical Wards
	C Surgical Wards	C Free*

* This group will have completed the work in Neurology–Psychiatry Dispensaries in the third quarter of the second year.

TABLE V

Present Curriculum, First Year

	First Quarter—September 30 to November 26					
	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
9–10	Anatomy	Anatomy	Anatomy	Anatomy	Anatomy	Anatomy
10–11	"	"	"	"	"	"
11–12	"	"	"	"	"	"
12–1	"	"	"	"	"	Physiological Chemistry
2–3	Histology-Neurology	**FREE**	Histology-Neurology	**FREE**	Histology-Neurology	**FREE**
3–4	"	"	"	"	"	"
4–5	"	"	"	"	"	"

	Second Quarter—December 1 to February 4					
	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
9–10	Physiological Chemistry	Anatomy	Physiological Chemistry	Anatomy	Physiological Chemistry	Anatomy
10–11	"	"	"	"	"	"
11–12	"	"	"	"	"	"
12–1	"	Physiology Lecture	"	Physiology Lecture	"	Physiology Lecture
2–3	"	Histology-Neurology	"	Histology Neurology	**FREE**	**FREE**
3–4	"	"	"	"	"	"
4–5	"	"	"	"	"	"

	Third Quarter—February 5 to April 2					
9–10	Physiology	**FREE**	Physiology	**FREE**	Physiology	**FREE**
10–11	"	"	"	"	"	"
11–12	"	"	"	"	"	"
12–1	"	"	"	"	"	"
2–3	"	"	"	"	Psychobiology	"
3–4	"	"	"	"	"	"
4–5	"	"	"	"	**FREE**	"

	Fourth Quarter—April 7 to May 27					
9–10	Histology-Neurology	**FREE**	Histology-Neurology	**FREE**	**FREE**	**FREE**
10–11	"	"	"	"	"	"
11–12	"	"	"	"	"	"
12–1	Bacteriology	"	Bacteriology	"	Bacteriology	"
2–3	"	"	"	"	"	"
3–4	"	"	"	"	"	"
4–5	"	"	"	"	"	"

TABLE VI

Present Curriculum, Second Year

	First Quarter—September 30 to November 26						Second Quarter—December 1 to February 4					
	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
9–10	Pharmacology	Pharmacology	**FREE**	Pharmacology	Pharmacology	**FREE**	**FREE**	Normal Physical Diagnosis	Neurology Diagnosis	Diagnostic Methods	Diagnostic Methods	Normal Physical Diagnosis
10–11	Pathology	**FREE**	Pathology	**FREE**	Pathology	"	Pathology	"	Pathology	"	Pathology	"
11–12	"	"	"	"	"	"	"	"	"	"	"	"
12–1	"	"	"	"	"	"	"	"	"	"	"	"
2–3	"	Pharmacology	"	Pharmacology	"	"	"	Psychiatry	"	**FREE**	"	**FREE**
3–4	"	Laboratory (1/2 class)	"	Laboratory (1/2 class)	"	"	"	"	"	"	"	"
4–5	"	"	"	"	"	"	"	**FREE**	"	"	"	"

	Third Quarter—February 5 to April 2						Fourth Quarter—April 7 to May 27					
9–10	Pathology	Pathology	Medicine	Medicine	Medicine	Medicine	**FREE**	**FREE**	**FREE**	**FREE**	**FREE**	**FREE**
10–11	Physical Diagnosis Gr. A Pathology Gr. B & C	Physical Diagnosis Gr. B Pathology Gr. A & C	Physical Diagnosis Gr. C Pathology Gr. A & B	Physical Diagnosis Gr. A Pathology Gr. B & C	Physical Diagnosis Gr. B Pathology Gr. A & C	Physical Diagnosis Gr. C Pathology Gr. A & B	"	"	"	"	"	"
11–12	"	"	"	"	"	"	"	"	"	"	"	"
12–1	"	"	"	"	"	"	"	"	"	"	"	"
2–3	Clinical Microscopy	Clinical Microscopy	**FREE**	Clinical Microscopy	Clinical Microscopy	**FREE**	"	"	"	"	"	"
3–4	"	"	"	"	"	"	"	"	"	"	"	"
4–5	"	"	"	"	"	"	"	"	"	"	"	"

TABLE VII

Present Curriculum, Third Year

	First Quarter—September 30 to November 26						Second Quarter—December 1 to February 4					
	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
9–10	Obst.	Obst. Gyn. (Groups)	Obst.	Obst. Gyn. (Groups)	Obst.	Obst.	Obst.	Obst. Gyn. (Groups)	Obst.	Obst. Gyn. (Groups)	Obst.	Obst.
10–11	A Medicine	A Medicine	A Medicine	A Medicine	A Medicine	A Medicine	A Surgery	A Surgery	A Surgery	A Surgery	A Surgery	A Surgery
11–12	"	"	"	"	"	"	"	"	"	"	"	"
12–1	Medical Clinic	Surgical Clinic	Psychiatry Lecture	Neurology Clinic	Surgical Clinic	Medical Clinic	Medical Clinic	Surgical Clinic	Medical Clinic	Therapeutics	Surgical Clinic	Medical Clinic
2–3	Medicine	Medicine	Medicine	Medicine	Medicine	**FREE**	**FREE**	**FREE**	**FREE**	**FREE**	**FREE**	**FREE**
3–4	"	"	"	"	"	"	"	"	"	"	"	"
4–5	"	"	Med. Zool. (Whole Class)	"	"	"	"	"	"	"	"	"

	Third Quarter—February 5 to April 2						Fourth Quarter—April 7 to May 27					
9–10 From March 1	Therapeutics	Hygiene	Pediatrics	Hygiene	Pediatrics	Hygiene	**FREE**	Hygiene April **FREE** (May)	**FREE**	Hygiene April **FREE** (May)	**FREE**	Hygiene April **FREE** (May)
10–11	Psych. Disp. 1/2 A	Neurol. Disp. 1/2 A	Neurol. Disp. 1/2 A	**FREE**	Psych. Disp. 1/2 A	**FREE**	"	**FREE**	"	**FREE**	"	**FREE**
11–12	"	"	"	"	"	"	"	"	"	"	"	"
12–1	Medicine	Surgery	Ophthal.	*Therapeutics Ophthal.	Surgery	Medicine	"	"	"	"	"	"
2–3	**FREE**	**FREE**	Laryngology in Groups all four quarters	**FREE**	**FREE**	**FREE**	"	"	"	"	"	"
3–4	"	"	"	"	"	"	"	"	"	"	"	"
4–5	"	"	"	"	"	"	"	"	"	"	"	"

TABLE VIII

Present Curriculum, Fourth Year

	First Quarter—September 30 to November 26						Second Quarter—December 1 to February 4					
	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
9–10	A Medicine	A Medicine	A Medicine (including Pediatrics)	A Medicine	A Medicine	A Medicine	A Surgery	A Surgery	A Surgery (including Ophthalmology)	A Surgery	A Surgery	A Surgery
10–11	"	"	"	"	"	"	"	"	"	"	"	"
11–12	"	"	"	"	"	"	"	"	"	"	"	"
12–1	"	"	"	"	"	Pediatrics 11:30–1	"	"	"	"	"	Pediatrics 11:30–1
2–3	"	"	"	"	"	FREE	A Ophthal-mology	Surgery	1/2 A Surgery 1/2 A Ophthal-mology	1/2 A Surgery 1/2 A Ophthal-mology	FREE	FREE
3–4	"	"	"	"	"	"	"	"	"	"	"	"
4–5	"	"	"	"	"	"	Surgical Pathology	"	Surgical Pathology	FREE	"	"

	Third Quarter—February 5 to April 2						Fourth Quarter—April 7 to May 27					
9–10	FREE	FREE	FREE	FREE	FREE	FREE	FREE	FREE	FREE	FREE	FREE	FREE
10–11	"	"	"	"	"	"	"	"	"	"	"	"
11–12	"	"	"	"	"	"	"	"	"	"	"	"
12–1	"	"	"	"	"	"	"	"	"	"	"	"
2–3	"	"	"	"	"	"	"	"	"	"	"	"
3–4	"	"	"	"	"	"	"	"	"	"	"	"
4–5	"	"	"	"	"	"	"	"	"	"	"	"

THE INFLUENCE OF DEHYDRATION ON THE PHENOMENA OF ANAPHYLAXIS IN GUINEA-PIGS[1,2]

MITCHELL I. RUBIN AND C. E. KELLETT[3]

From the Department of Pediatrics of the Johns Hopkins School of Medicine and the Harriet Lane Home of the Johns Hopkins Hospital

About one year ago Rothschild (1) working in the Harriet Lane Home, in an endeavor to determine the effect of dehydration on the intradermal tuberculin reaction, observed that there was a marked decrease in the allergic response to the intradermal passive transfer tests by the dehydrated child. It occurred to us at the time that this phenomenon might be a general rather than a purely local one. Therefore, we began a series of experiments with guinea-pigs designed with the object of testing the validity of this hypothesis and of studying the effect of dehydration on the allergic response of the entire organism.

Non-specific desensitization in anaphylactic animals has been studied by many investigators, and a large number of substances have been used to prevent anaphylaxis. These substances may be conveniently grouped according to their composition. Complex bodies such as sera have been used. Pfeiffer and Mita (2) protected sensitized animals against lethal doses of horse serum by previous injections of beef serum. Weil (3) used rabbit serum in effecting desensitization in guinea-pigs. Kellaway and Cowell (4) succeeded in protecting sensitized guinea-pigs by a previous injection of homologous (guinea-pig) serum. Sera which had previously been rendered "anaphylotoxic" by the addition of starch, agar, etc. have been found to confer protection by Dale and Kellaway (5). Biedl and Kraus (6) used peptone. Nickolaeff and Goldberg (7) employed India ink, Congo red, Trypan blue, substances commonly used in an endeavor to blockade the reticuloendothelial system, in order to prevent ana-

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[2] Submitted for publication June 25, 1931.

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phylactic shock in a sensitized animal. Kopaczewski and Vahram (8) were successful in attempts to prevent anaphylactic shock by the use of materials which alter surface tension, such as sodium oleate (2 to 3 cc. of a 1 per cent solution) saponin (5 per cent solution) and bile salts. Sodium hyposulphite was employed by Lumierre (9) for the same purpose and he also found by *in vitro* experiments, that the hyposulphite greatly inhibited precipitin formation.

Friedberger and Hartoch (10) used concentrated saline solution to protect animals, as did Richet, Brodin and Saint-Girons (11) and others. Sicard and Paraf (12) protected guinea-pigs by intravenous sodium-bicarbonate injections. Hiraba (13) obtained similar results with a group of caffein derivatives.

Pierret and Crampon (14) were able to protect guinea-pigs from anaphylactic death by starving them for thirty-six hours before shocking. They suggested that a short period of preliminary fasting might be used to advantage before administering sera to human subjects.

We are reporting a preliminary series of experiments which seem to show that dehydration protects the sensitized guinea-pig from anaphylaxis. A similar degree of dehydration protected guinea-pigs from lethal histamine shock.

The first part of our problem was to produce dehydration in a guinea-pig without impairing his general condition. Beside trying other methods, we fed a group of these animals a dry diet consisting of oats and hay which had a water content of 8.2 per cent. This method proved quite satisfactory, as is shown in table I, and more efficient than the other more elaborate procedures essayed.

It is apparent from table I that the effect of dehydration is more evident in the blood than in the tissues.

To determine whether dehydration would prevent anaphylaxis, experiments were performed in the following way: Sixteen guinea-pigs were taken. Eight were kept on a normal diet of oats, hay, greens and water; the others on the dehydrating diet. This regimen was continued until, on the fifth day, the guinea-pigs had lost from one-fifth to one-quarter of their original body-weights. Both groups were then passively sensitized with an intravenous injection of 1.25 $\times$ the minimum lethal sensitizing dose of rabbit anti-horse serum. (This dose was calculated for the normal guinea-pig weighing between 175

TABLE I

Changes occurring as result of dehydrating diets

GUINEA-PIGS	DIET	WEIGHT AT ONSET	WEIGHT AT END	PER CENT OF WEIGHT CHANGE	PER CENT MUSCLE WATER	PER CENT SERUM VOLUME TO TOTAL BLOOD VOLUME	ALBUMIN GLOBULIN RATIO	REFRACTOMETER READINGS ON BLOOD SERUM
Group I	Normal							
451		368	391	+6	73	39	4.45/1.87	6.9
450		313	298	−4	72.9	43	4.58/1.36	7.8
448		253	260	+3	73	41	4.20/1.48	6.87
Group II	Dry							
446		316	182	−40	72.7	33.3	5.57/1.17	8.7
449		321	175	−45	75.3	37	5.00/1.33	8.75
447		236	121	−50	73.8	34	5.04/1.31	8.7

TABLE II

Effect of dehydration on passive anaphylaxis

NUMBER OF GUINEA-PIGS	DIET	WEIGHT AT ONSET	WEIGHT AT END	PER CENT OF WEIGHT CHANGE	RESULTS	
465	Dry	225	161	−29	Sniffling—scratching nose	Recovery
461	Dry	196	149	−24	Dyspnea—1 convulsion	Recovery
464	Dry	186	158	−15	Sniffling—increased respirations	Recovery
467	Dry	160	114	−29	Many convulsions	Recovery
475	Dry	203	143	−30	Scratching of nose	Recovery
472	Dry	196	148	−24	Severely shocked	Recovery
473	Dry	180	136	−24	Shocked	Died in 3 minutes
474	Dry	188	140	−25	Shocked	Died in 3 minutes
466	Normal	156	175	+12	Shocked	Died in 3 minutes
468	Normal	213	234	+10	Shocked	Died in 3 minutes
469	Normal	216	227	+5	Shocked	Died in 3 minutes
470	Normal	265	278	+5	Shocked	Died in 3 minutes
462	Normal	181	195	+8	Severely shocked	Died in 2 hours
477	Normal	184	197	+7	Shocked	Died in 3 minutes
480	Normal	200	217	+8½	Shocked	Died in 3 minutes
481	Normal	179	181	+1	Shocked	Died in 3 minutes

and 250 grams.) Twenty-four hours later they were given a shocking dose of 0.5 cc. of horse serum intravenously. The results of this experiment are summarized in table II.

It was of interest to note that the control animals that survived appeared to be more disturbed and sick for a longer time after injection than any of the dehydrated animals that survived. These as a rule made an unusually rapid recovery.

In order to answer the question as to whether or not the process of dehydration might possibly have interfered with the sensitization of

TABLE IIA

Control experiment with different batch of serum

The dosage of sensitizing serum was varied in this group of animals. It will be noticed that the one control animal to survive received one-half the usual sensitizing dose (0.5 cc.). The table shows that the dehydrated animals received a much larger amount of antiserum than did the control animals per unit of body weight.

NUMBER OF GUINEA PIGS	DIET	PER CENT OF WEIGHT CHANGE	SENSITIZING DOSE	SENSITIZING DOSE PER GRAM BODY WEIGHT	RESULTS	
				cc.		
478	Dry	−29	½ cc. R.A.H.	0.0035	No symptoms	Recovery
482	Dry	−29	½ cc. R.A.H.	0.0033	Increased respirations for short period	Recovery
481	Dry	−29	½ cc. R.A.H.	0.0032	Convulsions—dyspnea	Died in 3 minutes
477	Dry	−38	¼ cc. R.A.H.	0.0019	No symptoms	Recovery
480	Dry	−34	¼ cc. R.A.H.	0.0019	No symptoms	Recovery
472	Normal	0	½ cc. R.A.H.	0.0022	Convulsions—dyspnea	Died in 3 minutes
486	Normal	+3	½ cc. R.A.H.	0.0020	Convulsions—dyspnea	Died in 3 minutes
484	Normal	−1	½ cc. R.A.H.	0.0028	Convulsions—dyspnea	Died in 3 minutes
485	Normal	+3	¼ cc. R.A.H.	0.0010	Convulsions—dyspnea	Died in 3 minutes
487	Normal	+2½	¼ cc. R.A.H.	0.0010	Dyspnea	Recovery

our experimental animals, the following experiments were performed. Two virgin guinea-pigs were dehydrated. Of these one was sensitized by the method above described. The other served as a control. The horns of the uteri of these animals were suspended in 15 cc. of Ringer's solution. One-half cubic centimeter of horse serum was added to

demonstrate that sensitization had occurred. In each instance $\frac{1}{25}$ mg. of histamine was subsequently added to test the capacity of the muscle to react to stimuli.

The following kymographic tracings show that the dehydrated guinea-pigs were actually sensitized.

KYMOGRAPHIC TRACINGS OF UTERINE CONTRACTIONS

461 (B), nonsensitized animal. 455 (A), sensitized animal. H.S. = horse serum. H. = histamine. When horse serum was added to the bathing fluid of the nonsensitized uterus no contraction occurred; when it was added to the bathing fluid of the sensitized uterus a marked contraction occurred. In both instances the subsequent addition of histamine produced a marked contraction.

Since Dale (15), for reasons summarized in his Croonian Lectures of 1929, believed that histamine was probably the most important substance liberated on cell destruction and was in itself responsible for most of the symptoms of anaphylaxis, we found it necessary to study the effect of dehydration on the so-called "histamine shock."

If the ideas of Dale are correct, the march of events which takes place when antigen is injected into the body of a sensitized animal proceeds in two phases as follows: (1) There is at first injury to the cells of the body, which is the direct effect of the antigen itself but which, *per se*, does not produce the apparent phenomena of anaphylaxis. (2) As the result of the injury to the cells, histamine and other substances are liberated from the traumatized protoplasm and thrown into the circulation to produce the clinical picture which we call anaphylactic shock.

We felt that should the foregoing hypothesis concerning the course of events in the production of anaphylaxis prove to be the correct one, it might be possible to demonstrate experimentally the mechanism by which dehydration afforded protection. We had been able to show that the cells of our dehydrated animals were sensitive to our antigen and, therefore, susceptible to injury from it. If dehydration failed to protect against "histamine shock," then the withdrawal of fluid from the body must have been effective by protecting the individual cells from the insult offered by the antigen.

As a preliminary step, then, toward an experimental study of the mechanism involved in the immunity which dehydration confers against anaphylaxis, a series of guinea-pigs was prepared according to the method described above. Following dehydration the animals were injected with histamine in solution. The series was adequately controlled, as is shown in table III.

Table III shows that dehydration not only protects against anaphylactic death but also against "histamine shock," and since this is the case, it is not possible by this type of experiment to obtain any information as to whether or not the immunity which dehydration affords is in any way dependent on the protection of the individual cell. Our results in this case do, however, suggest that protection may be given the neuro-visceral system, if this is indeed the *locus minoris resistantiae* against histamine.

TABLE III

Effect of dehydration on histamine shock

NUMBER OF GUINEA-PIGS	DIET	WEIGHT AT ONSET	WEIGHT AT END	PER CENT OF WEIGHT CHANGE	ACTUAL DOSE	DOSE PER GRAM	RESULT	
486	Dry	256	191	−25	1/25	1/4775	Slight dyspnea—weakness	Recovery
485	Dry	224	162	−27	1/25	1/4050	Slight dyspnea—marked weakness	Recovery
484	Dry	235	170	−26	1/25	1/4250	Marked weakness—no dyspnea	Recovery
487	Dry	182	142	−21	1/25	1/3600	Severely shocked—marked dyspnea. Convulsions—rapid recovery	Recovery
490	Dry	250	203	−19	1/21	1/4100	No reaction	Recovery
492	Dry	242	205	−15	1/21	1/4100	Two convulsions—rapid recovery	Recovery
430	Dry	204	162	−20	1/21	1/3200	Dyspnea—1 convulsion—rapid recovery	Recovery
493	Dry	192	167	−15	1/21	1/3200	Severely shocked—convulsions	Recovery
489	Dry	230	179	−22	1/17	1/3000	Severe convulsions—dyspnea	Recovery
404	Normal	170	183	+9	1/25	1/4600	Severely shocked—convulsions	Recovery
408	Normal	162	186	+1.3	1/25	1/4650	Severely shocked—died	Died
560	Normal		153		1/25	1/3800	Severely shocked—died	Died
561	Normal		190		1/25	1/4750	Severely shocked—dyspnea—1 convulsion	Recovery
427	Normal	157	192	+2	1/21	1/3850	Convulsions—dyspnea	Died
423	Normal	146	186	+27	1/21	1/3710	Severely shocked—many convulsions	Died
426	Normal	160	187	+17	1/21	1/3750	Severe convulsions—severely shocked. Recovered—subsequently died	Died
417	Normal	217	261	+17	1/21	1/5200	Severely shocked—convulsions—recovery	Recovery
422	Normal	205	238	+16	1/17	1/4000	Severely shocked—convulsions—died	Died

Chart I is inserted to demonstrate the rapid rise in the weight curve of dehydrated guinea-pigs following their return to a normal diet. This total gain cannot entirely be accounted for by the increase of

intestinal contents of the guinea-pig and indicates that retention of water has taken place.

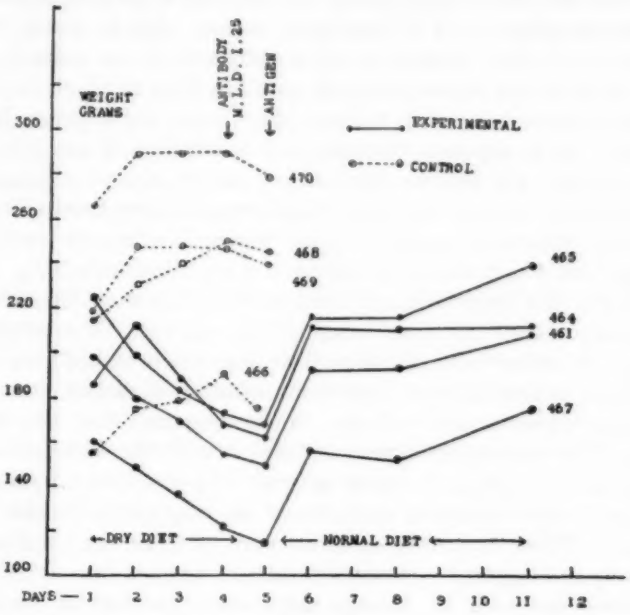

CHART I

DISCUSSION

The manner by which dehydration affects protection to the sensitized guinea-pig is as yet not clear. It seems to us highly probable that many of the means which have been used in the past to obviate the occurrence of anaphylactic phenomena may be effective because their use has resulted in the removal of water from the body of the protected animal. Friedberger and Hartoch were able to protect their animals from shock by injecting hypertonic salt solution two minutes before giving the shocking dose of antigen. These observers thought that the beneficial results were due to the inhibitory action of the salt on the complement. Ritz obtained protection from the injection of proteotoxins by the same means, thus demonstrating that the effect

of hypertonic salt solution is not of necessity due to alteration of complement action. Richet and his co-workers, using hypertonic salt solutions, relate the protection thus afforded to his general theory of "metatrophism." It is interesting to note that he states: "An injection of sodium chloride is anti-anaphylactic if one waits for no more than an hour before giving the shocking dose, and if the dose of sodium chloride injected is not less than 0.3 gm. per kilogram body weight." It is apparent that such a concentration of salt injected intravenously will produce dehydration; and the second stipulation, that no more than an hour must elapse, may be correlated with the fact that dehydration produced in this manner is extremely transient.

Dale (16) found that if the uterus of a sensitized guinea-pig were suspended in a hypertonic salt solution, the addition of the antigen no longer caused the usual anaphylactic reaction. This observer varied the concentration of the fluid medium which bathed his preparations of muscle by using hypertonic solutions of various strengths and also hypotonic salt solutions. He demonstrated that very slight shifts of the concentration produced alteration in the contractions of the muscle. So slight a change as from 0.9 per cent to 1.3 per cent produced almost complete extinction of the response to the shocking antigen. When hypotonic solutions were used, an exaggeration of the response occurred. In some instances, when a non-electrolyte (glucose) was used to increase the osmotic pressure of the fluid medium, diminution in the response also occurred. He concluded that the protection offered by the hypertonic solutions against acute anaphylaxis was due to the decreased irritability of the smooth muscle which exposure to these solutions created. He also suggested that this effect might have been brought about by the withdrawal of water from the muscle strips and concentration of the contained salts. Dale was moreover able to demonstrate by experimentation that, when concentrated solutions were used as the bathing fluid for his strips of muscle, there was a union of the antigen and antibody on the cells, and desensitization occurred even though no visible contraction of the muscle resulted.

Pellathy and Haintz (17) injected intraperitoneally hypertonic sodium bicarbonate (6 cc. of an 8 per cent solution) daily for one week to protect actively sensitized guinea-pigs from shock. However,

when 1 cc. of an 8 per cent $NaHCO_3$ solution was given with the shocking dose, no protection was afforded the animals. This, too, suggests that the immunity, which they thought resulted from sympathetico-tonia due to alkalosis, probably was induced through the dehydration of the animals.

Dehydration by means of diets that diminish retention of water is being used in the Protein Clinic of the Harriet Lane Home on asthmatic children. Though this has been carried on for only a few months, the results are very encouraging. This work will be the subject for a further communication.

SUMMARY

1. Dehydration is shown to protect a sensitized guinea-pig from anaphylactic shock.

2. The experiments with histamine suggest that the protection thus afforded is in part, at any rate, due to diminished irritability of smooth muscle.

3. We have pointed out that dehydration may explain the success of many of the other anti-anaphylactic procedures.

4. The clinical application of the results of our experiments are encouraging.

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HENRY M. THOMAS, M.D.

PRESENTATION OF THE PORTRAIT OF DR. HENRY M. THOMAS

LEWELLYS F. BARKER, M.D.

Remarks made at the Commemoration Day Exercises of the Johns Hopkins University, February 23, 1931

Six years ago the Johns Hopkins Hospital lost its first Visiting Neurologist and the Medical School of the Johns Hopkins University its first Clinical Professor of Neurology. These institutions had, for over thirty years, availed themselves of the devoted services of Dr. Henry M. Thomas, as occupant of these positions. He was an expert practitioner of his art—first rate in diagnostic ability and resourceful in treatment; he was a painstaking and thorough teacher—clear, objective and impressive; he was a valued contributor to medical knowledge; and he was a man who compelled not only the high esteem but also the genuine affection of his patients, his students and his professional colleagues.

Born in Baltimore in 1861, he came of Quaker antecedents. His father was the late Dr. James Carey Thomas (a medical practitioner and a trustee of the Johns Hopkins University) and his mother was Mary Whitall, the parents bearing family names well known to all who are familiar with the history of the "Society of Friends" in America. His sister, Miss M. Carey Thomas, was for many years the distinguished President of Bryan Mawr College.

Studying first in Baltimore schools and later at Haverford College, he returned to the Johns Hopkins University, a fellow student with Councilman and Howell, receiving the A.B. degree here in 1882. Three years later he graduated in medicine at the University of Maryland where his interest in neurology was aroused by Professor Miles. After graduation, he pursued his neurological studies further in Europe and profited by the teaching of the anatomist, Gegenbauer, and of the expert in electrical diagnosis, Schultze, and, above all, of that great master of clinical neurology, Wilhelm Erb of Heidelberg. He was also favorably influenced by the work of the neurological group at

Queen's Square Hospital in London, especially by the studies of Gowers and Victor Horsley and his own subsequent work was stamped with the imprint of these distinguished English and German teachers.

When he returned to Baltimore, the construction of the Johns Hopkins Hospital had not yet been completed, but he found a welcome in the Pathological Institute on the hospital grounds, where he joined a group (including Councilman, Halsted and Mall) that worked leisurely but effectively under the inspiration of Professor Welch. He began practice and was appointed Attending Physician to Bay View Hospital, but his real opportunity for clinical work came when Dr. Osler, soon after assuming the duties of Physician in Chief to the Johns Hopkins Hospital in 1889, placed him in charge of the Neurological Division of the Out-Patient Department, and, when the Medical School opened, chose him as its teacher of clinical neurology. Osler and Thomas soon became warm friends; the advent of the great internist "ushered in the complete realization of long deferred hopes," and the neurologist proudly asserted that what there was of good in him as a teacher and a physician he owed to Osler.

Of the professional work of Dr. Thomas, as practitioner, teacher and investigator, accounts have been published in the neurological journals; time will not permit of any extensive discussion of it this morning. It may suffice to say that as a writer, though he was not prolific, some clinical or anatomical paper of importance was contributed on the average of once a year and each of them was characterized by accuracy of observation, keen critical acumen and due regard for the work of others; that, as a teacher, he knew how, in a simple and unaffected way, to educate his assistants and his students gradually and systematically to skill in the application of practical, technical methods, and to the utilization of the data accumulated for judgments as to the parts of the nervous system involved in disease and as to the nature and mode of origin of the maladies before them, as well as to the wisest plans of treatment; and that, as a consulting practitioner, his large personal experience, his exceptional powers of analysis, his tactfulness in handling delicate situations, and his quick and broad human sympathies made him not only very useful to patients but also a joy to practitioners who sought his aid in the unravelling of neurological difficulties. In every part of his professional activities, one

felt his reverence for facts, his knowledge of the significance of facts, and his determination to make the best possible use of the facts for the good of his patients; indeed, his ability to pierce to the heart of a neurological situation was extraordinary.

Though these professional abilities of Dr. Thomas were admirable and were highly prized, it was for the character and personality of the man that the acme of appreciation of those who knew him best was reserved. Handicapped not only by a severe recurrent migraine, but by a still more serious malady, pulmonary tuberculosis, which in its acute stage necessitated in 1888 a stay in the Adirondacks under the affectionate care of Trudeau, and which slowly progressed throughout his life and was largely responsible for his terminal illness, he never reacted with bitterness but bore his ills with fortitude, transmuting his discomforts and the obstacles to his ambitions into increased sympathy for the sufferings of others. Like his close friend Trudeau, he maintained a constant cheerfulness and a radiant optimism. Those who were privileged to enjoy the hospitality of his home and of his family quickly came under the spell of his personal charm. One of his patients has written appreciatively of his dancing mobile eyes, of his delicious humor, of his gay laughter, of his hatred of shams, and of his unfailing charity; for her his medical wisdom and depth came to realization only after she had become acquainted with the "still more fundamentally endearing qualities of love, humor and flawless honesty."

On behalf of the family I have been asked, Mr. President, to present to the University, through you, a posthumous portrait of Dr. Thomas, painted by Mr. Thomas C. Corner. We rejoice that the excellent likeness may be permanently preserved as a supplement to the indelible memories treasured in our hearts.

DIABETES MELLITUS AND PREGNANCY

C. H. PECKHAM

From the Department of Obstetrics, Johns Hopkins University and Hospital

In 1927, the author, with H. J. Stander, reported observations on four women suffering from diabetes mellitus, who had been followed through seven pregnancies. It was pointed out that the utilization of insulin had materially altered our views concerning the pregnant diabetic, and that a much more favorable prognosis could be given than was believed possible by Matthews Duncan in 1882. Although during the early months of the pregnancy the diabetes showed no amelioration and, indeed, was somewhat aggravated, yet during the last four months a distinct improvement in the condition was noted and this sometimes persisted for several months after delivery. It was believed that the average diabetic could be safely carried to term under careful supervision, and that she would be left in as good condition as she had been prior to the pregnancy.

The literature on the subject of diabetes and pregnancy was well summarized by Lambie in 1926, to whom the reader is referred for historical details. During the past four years, a number of other communications have appeared dealing with this topic. At the present time, there appears to be a fairly general belief that the mild and moderately severe diabetic under careful supervision will go through pregnancy and labor with a fair degree of safety. Umber and Rosenberg, however, point out that in severe cases the reaction is often bad and may necessitate premature termination of the pregnancy. They also believe that ketonuria occurs frequently and is produced more easily during pregnancy; and a number of cases of diabetic coma near term are reported in the literature, some resulting fatally. Smith and Roques, Hansen, Markler, and others comment on the occurrence of marked hypoglycemic reactions during the early puerperium and Kaufmann reports the death of a patient on the fifth day of the puerperium in hypoglycemic coma. Several workers report a marked decrease in the insulin requirement during the puerperium, although

CASE 1

PATIENT H. M., UNIT 1948, BORN 1883, COLORED

DATE	DURATION	URINE—SUGAR PER DAY	BLOOD SUGAR	BLOOD CO_2	ACETONE	DIACETIC	UNITS INSULIN	REMARKS
First two pregnancies normal except for mild toxemia during second. Diabetes diagnosed in 1919. Treated 2 months in Medical Clinic, and discharged on diet with a normal blood sugar and with no sugar in the urine								
Third pregnancy								
		[GMS]						
6/ 8/23	4½ mos.	12.8	0.194		0	0	0	
7/10/23	5½ mos.	22.5	0.167		0	0	0	
7/24/23	6 mos.	20.7			0	0	0	
7/27/23	6 mos.	0						On this date, spontaneous premature delivery of an immature, stillborn child, premature separation of placenta
Fourth pregnancy								
1/12/26	3½ mos.	9.4	0.147		0	0	0	
2/ 5/26	4½ mos.	3.0	0.154		0	0	45	
3/10/26	5½ mos.	1.0	0.153		0	0	40	
5/ 1/26	+7 mos.	1.2	0.091		0	0	38	
5/19/26	8 mos.	1.9	0.095		0	0	38	Moderate insulin reaction
6/ 5/26	9 mos.	0	0.118		0	0	0	Insulin stopped 6/3/26
6/ 8/26	Day of delivery	0	0.149		0	0	0	Labor induced because of vomiting. Child alive, weight
6/15/26	7 days P. P.	0	0.158		0	0	0	2750 gms.
6/18/26	10 days P. P.	0	0.182		0	0	0	Discharged from hospital. Failed to return for several months, when insulin was again necessary. Died at home in 1929, pneumonia

This patient had a moderately severe diabetes, first diagnosed in 1919. Throughout the third pregnancy, which terminated at 6–6½ months with premature separation of the placenta, the blood sugar was high and there was marked glycosuria. The patient was carefully supervised during the fourth pregnancy. Rigid diet and considerable insulin (45 units) were necessary to keep her in good condition. At about the eighth month insulin reactions appeared and for several days prior to delivery the urine was sugar-free, no insulin being used, although the blood sugar was relatively high. On discharge from the hospital, 10 days after delivery, there was still no sugar in the urine, except for a trace of lactose. The patient was unable to nurse her baby.

CASE 2

PATIENT J. S., UNIT 2840, BORN 1887, WHITE

DATE	DURATION	URINE SUGAR PER DAY	BLOOD SUGAR	BLOOD CO_2	ACETONE	DIACETIC	UNITS INSULIN	REMARKS
The first two pregnancies were normal, except for a toxemia during the second. Diabetes was diagnosed in January, 1920, and the patient was under observation from that time								
		grams						
3/30/20		0.3%	0.194		+	+	0	
5/ 4/20		16.0	0.217		+	0	0	
				Third pregnancy				
9/29/20	3 mos.	5.0			+	0	0	
10/23/20	4 mos.	0	0.084		0	0	0	
11/12/20	−5 mos.	0	0.090		0	0	0	
3/ 9/21	Day of delivery	0			0	0	0	Spontaneous delivery. Child alive, weight 3930 gms. Nursed baby 5 mos. Followed in diabetic clinic, urine occasionally contained sugar
				Fourth pregnancy				
6/ 5/23	Not pregnant	0.1%			0	0	0	
5/13/24	1 mo.	6.0			0	0	0	
8/12/24	4 mos.	4.6	0.174		+	0	0	
9/ 7/24	5 mos.	0	0.187		0	0	0	
11/11/24	7 mos.	0	0.122		+	+	0	
1/ 6/25	+8½ mos.	0			0	0	0	
1/20/25	Day of delivery	0	0.121		0	0	0	Spontaneous delivery. Child alive, weight 4670 gms.
7/14/25	6 mos. P. P.	7.5			0	0	0	Nursed baby at least 1½ mos.
7/27/26	1½ yrs. P. P.	6.8			0	0	0	Patient living. Now requires moderate amount of insulin

This patient was observed during two pregnancies subsequent to the development of diabetes. In both the diabetic condition improved, beginning at about the fourth month. In each instance this improvement continued for some time during the puerperium, for at least as long as the patient is known to have suckled her child. In both pregnancies ketonuria was present during the early months, but disappeared by the time the last trimester was reached. The diabetes is apparently mild, and the patient, who is cooperative concerning the diet, is in good condition after ten years, though insulin is now necessary to keep the urine sugar-free.

Holzbach considers that, once the pregnancy is over, the diabetes will rapidly return to its former level. The percentage of abortions and still-births is still high, and the infants born alive tend to be well above the average in size but frequently present various congenital malformations.

It seems generally agreed that, since the use of insulin has become relatively common, many more diabetic women, previously sterile, are becoming pregnant. Thus, the problem to the obstetrician of the care of such patients becomes more vital, particularly in view of the diversity of opinion still persisting on this subject, and the gloomy prognosis which is frequently given.

Since the appearance of the above-mentioned report in 1927, eight other diabetic women have been delivered one or more times on the obstetrical service of the Johns Hopkins Hospital. Thus, our series at the present time includes twelve patients observed through eighteen pregnancies. In four patients, the diabetes was first diagnosed during a pregnancy, and three of these had had no symptoms up to that time, rendering it probable that the diabetic condition had developed during the pregnant state. The remaining eight women had been known diabetics for from one to ten years, and hence in them we were able to observe the actual effect of the pregnancy on the diabetes. In most instances, then, we have observations on these patients before, during, and after the pregnancy.

The tabulated case histories give in abstract the course of each case during the time of observation, together with remarks concerning the general impression which the patient has made. These tables include the urinary sugar in grams excreted per twenty-four hours; the fasting blood sugar and carbon-dioxide-combining power; the presence or absence of acetone and diacetic acid in the urine; the insulin administration in units per day; and finally, the course of and outcome to the pregnancy. The diet used in each case is not included in the tables. This point will be discussed later; but we may state now that in most cases it was sufficient to afford calories 20 to 25 per cent above basal requirements, and with a $\frac{FA}{G}$ ratio usually well below 1.5.

Of the twelve women in the series, ten are now alive and have had

CASE 3

PATIENT M. M., UNIT 2103, BORN 1888, WHITE

DATE	DURATION	URINE SUGAR PER DAY	BLOOD SUGAR	BLOOD CO_2	ACETONE	DIACETIC	UNITS INSULIN	REMARKS
First 3 pregnancies apparently normal. Diagnosis of diabetes and nephritis made in 1916; blood sugar 0.237 and 4 per cent sugar in urine, acetone and diacetic acid. Under diet, urine became sugar-free. Stillborn, premature child delivered elsewhere in 1922								
Fifth pregnancy								
		grams						
2/10/25	−7 mos.	23.0			+	+	0	
2/25/25	+7 mos.	1.98	0.121		+	0	10	
3/ 3/25	7½ mos.	Tr.	0.124		0	0	20	
4/19/25	Term	0	0.118		0	0	30	Complicating nephritic toxemia
4/21/25	Day of delivery	0			0	0	30	Labor induced. Child alive. Weight 3090 gm. Nursed
7/28/25	3 mos. P. P.	0	0.116		0	0	24	baby 9 months
1/21/26	9 mos. P. P.	0	0.093		0	0	0	Sugar reappeared in urine. Kept in fair condition on diet and 20 units insulin daily
Sixth pregnancy								
4/ 8/30		Tr.			0	0	20	L.M.P. 5/13/30
5/27/30	2 wks.	12.0			0	0	20	
7/ 8/30	−2 mos.	40.0			0	0	20	
8/19/30	+3 mos.	Tr.			0	0	20	
9/30/30	4½ mos.	17.2			0	0	30	
10/28/30	5½ mos.	10.2	0.133		0	0	30	
11/19/30	+6 mos.	9.7	0.124		0	0	40	
12/18/30	+7 mos.	0			Tr.	Tr.	40	Complicating nephritic toxemia
1/13/31	8 mos.	0	0.080	36.2	0	0	36	
1/23/31	8½ mos.	0	0.078		0	0	26	
1/27/31	Day of delivery	0	0.085		0	0	20	Labor induced. Child alive, weight 3120 gms.
1/29/31	2 days P. P.	0			0	0	15	Nursing infant
2/ 2/31	6 days P. P.	0	0.098	43.8	0	0	10	
2/13/31	17 days P. P.	0	0.087		0	0	0	
2/26/31	1 mo. P. P.	4.9			0	0	0	Breast milk practically gone

This patient is known to have had diabetes since 1916. Unfortunately, she was not followed during the pregnancy of 1922, nor until the seventh month of the one in 1925. During this latter pregnancy it was necessary to give her insulin to term in order to keep her sugar-free. However, 9 months after delivery she was without insulin and nursing her baby. The sixth, or last pregnancy, was carefully studied. The diabetes had progressed so that 20 units of insulin a day were necessary to keep her sugar-free prior to conception. During the first 7 months this amount had to be raised to 40 units, and even with this, glycosuria was constantly present. By the time term was reached only 20 units were necessary and within the first two weeks of the puerperium it was possible to do away with the insulin entirely. Sugar reappeared in the urine coincidently with the failure of lactation. It is interesting that during these last two pregnancies the patient had a rather severe complicating toxemia, apparently nephritic in origin.

CASE 4

PATIENT M. J., UNIT 4123, BORN 1899, WHITE

DATE	DURATION	URINE SUGAR PER DAY	BLOOD SUGAR	BLOOD CO_2	ACETONE	DIACETIC	UNITS INSULIN	REMARKS
			First pregnancy					
		grams						
4/21/26	3 mos.	8.8	0.143		0	0	0	Patient referred by her physician who had recently diagnosed diabetes
4/28/26	+3 mos.	1.9	0.133		0	0	0	
6/28/26	+5 mos.	0	0.143		0	0	0	
10/12/26	Day of delivery	0						Forceps delivery. Child alive, weight 3400 gms.
10/15/26	3 days P. P.	0	0.087		0	0	0	
1/11/27	3 mos. P. P.	0	0.130		+	+	0	Followed since. Can be kept sugar-free on diet

This patient seems to have a very mild diabetes. However, the continued hyperglycemia, together with the presence of some sugar in the urine, occasionally seems to make the diagnosis subject to very little doubt. Certainly the condition became no worse during the pregnancy.

known diabetes for from one to fifteen years, with an average of about six years per patient. One woman, in whom diabetes was diagnosed in 1919, was followed through two pregnancies, and died of pneumonia in 1929, three years after the birth of her last child. The other death occurred in a woman who was admitted to the ward for the first time when eight months pregnant, having been in diabetic coma for forty-eight hours. Despite the administration of insulin and fluids, she

died a few hours after admission. This is the only death due to diabetes in the series up to the present time.

A study of the appended case reports would seem to indicate that there is often little if any immediate upset in carbohydrate metabolism

CASE 5

PATIENT M. M., UNIT 16,374, BORN 1910, WHITE

DATE	DURATION	URINE SUGAR PER DAY	BLOOD SUGAR	BLOOD CO_2	ACETONE	DIACETIC	UNITS INSULIN	REMARKS
Found to have diabetes in 1923, at age of 13. Followed in diabetic clinic since. Diabetes mild and controlled by diet alone								
		grams						
3/17/27		0	0.070		0	0	0	
First pregnancy								
12/ 6/27	5 mos.	1.1				0	0	L.M.P. 6/29/27
1/10/28	+6 mos.	0			0	0	0	
2/ 9/28	+7 mos.	Tr.			+	Tr.	0	
3/ 8/28	+8 mos.	0			0	0	0	
4/ 5/28	Term	0	0.077	51.3	0	0	0	Spontaneous delivery 4/7/28.
4/ 9/28	2 days P. P.	0	0.047	50.0	0	0	0	Child alive. Weight 3100 gms.
4/20/28	13 days P. P.	0	0.058		0	0	0	Child breast-fed 2 weeks
7/24/28	3½ mos. P. P.	0			0	0	0	
12/27/28	8½ mos. P. P.	1.8	0.087		0	0	0	Since this time the diabetes has easily been controlled by diet. Shows sugar only when she breaks diet

In this patient, the diabetes appeared at the age of 13, and she was only 17 at the time of the pregnancy. The diabetes was easily controlled during the pregnancy by diet alone. It should be noted that a marked hypoglycemia was present during the early puerperium, the fasting blood sugar being only 47 mgm. per cent two days after delivery.

as the result of the onset of pregnancy. Indeed, in the milder cases no change in the condition was apparent throughout its course (cases 5 and 7). The remaining cases seem to show that at some time during the first four months of pregnancy the diabetes becomes somewhat

CASE 6

PATIENT M. B., UNIT 7798, BORN 1900, BLACK

DATE	DURATION	URINE SUGAR PER DAY	BLOOD SUGAR	BLOOD CO_2	ACETONE	DIACETIC	UNITS INSULIN	REMARKS
		Eighth pregnancy						
		grams						
9/ 8/26	−8 mos.	18.9			0	0	0	First 7 pregnancies apparently
9/23/26	+8 mos.	28.5	0.124		0	0	0	uneventful except for syphilis. Diabetes diagnosed in antenatal clinic during 8th month of pregnancy
9/27/26	1 day P. P.	0	0.080	56.0	0	0	0	Premature spontaneous delivery 9/26/26. Child stillborn,
10/ 1/26	5 days P. P.	Tr.	0.121	61.3	0	0	0	syphilis. Weight 2110 gms.
		Ninth pregnancy						
6/ 8/29	1 day P. P.	0.3%	0.063	43.7	0	0	0	The patient did not return for control of diabetes. She was
6/18/29	11 days P. P.	0	0.118	40.3	0	0	0	admitted 1 day after a premature spontaneous delivery 6/7/29
		Tenth pregnancy						
10/17/29		8.0			0	0	0	L.M.P. 10/25/29. Patient fol-
11/14/29	2 wks.	5.1			0	0	0	lowed carefully throughout
12/12/29	1½ mos.	5.1			0	0	0	this pregnancy, and syphilis
1/23/30	3 mos.	4.8			0	0	0	is well treated
2/19/30	4 mos.	1.01	0.087	49.5	0	0	0	
3/20/30	5 mos.	25.0			0	0	0	
4/24/30	6 mos.	25.0			0	0	0	
7/ 1/30	+8 mos.	18.2	0.173		0	0	0	Admitted to hospital 7/2/30.
7/ 7/30	+8 mos.	1.0			+	0	0	Spontaneous delivery 7/8/30.
7/10/30	2 days P. P.	0.6	0.094	48.5	0	0	0	Child alive, 2740 gm.
7/18/30	10 days P. P.	0.4	0.083		0	0	0	Nursed baby 5 months
10/28/30	3½ mos. P. P.	4.8			0	0	0	Constantly breaks diet
1/27/31	6 mos. P. P.	3.4			Tr.	Tr.	0	

Diabetes was first diagnosed in this patient during the 8th month of her eighth pregnancy, which was the first time she had come to the Clinic. Syphilis was a complicating factor and was responsible for the premature delivery of a stillborn macerated foetus. Following her discharge from the hospital she was not seen again until the birth of another premature infant. During her last (her tenth) pregnancy she was followed closely and the syphilis well treated. Glycosuria was constantly observed and apparently was more marked from the fifth month on. The patient, though fairly coöperative, was extremely unintelligent and was unable to keep a proper diet. This was evident from the fact that the urinary sugar on July 1, 1930, was 18.2 gms., while on July 7th, after five days in the hospital during which time she was on the same diet that she was supposed to be following at home, it had fallen to 1.0 gm. in the 24-hour specimen. During the early days of the puerperium the blood sugar was approximately normal and very little glycosuria was observed. The latter increased after the patient left the hospital, again apparently as a result of dietary indiscretions.

aggravated, often with considerable sugar in the urine necessitating an increase in the administration of insulin and a more rigid diet. However, as term is approached, the patients, who up to that time have become worse, seem to improve greatly. This improvement is sometimes noted as early as the fifth month of pregnancy, but occasionally, in the more severe cases, does not become apparent until about a month before term.

These changes occurring in the diabetic condition during pregnancy and illustrated very well in the abstracts of case 10 and case 3. Mrs. J. L. was diagnosed as having diabetes in 1928, and after study on the medical wards, it was found that the condition could be controlled with diet and 30 to 32 units of insulin per day. During the first two months of her pregnancy, occurring two years later, there was no apparent change in her condition. However, at the fifth month marked glycosuria appeared and persisted, despite an increase in insulin dosage to 40 units. At the eighth month the urine became sugar-free and remained so, despite a decrease in insulin dosage to 26 units. The patient was delivered, two weeks before the estimated date of confinement, of a living child, and throughout the first month of the puerperium there was never more than a trace of sugar in the urine, the diet and insulin being held at the level reached before delivery.

Mrs. M. M. had been treated in the diabetic clinic and had already been successfully carried through one pregnancy. Her diabetes was under control with diet and 20 units of insulin. Glycosuria appeared

CASE 7

PATIENT M. B., UNIT 20,801, BORN 1888, BLACK

DATE	DURATION	URINE SUGAR PER DAY	BLOOD SUGAR	BLOOD CO_2	ACETONE	DIACETIC	UNITS INSULIN	REMARKS
			Seventh pregnancy					
		grams						
8/30/28	+3 mos.	5.85					0	Patient first seen and diabetes
9/22/28	4 mos.	Tr.	0.091	44.8	+	+	0	diagnosed in 3rd month of
11/14/28	−6 mos.	0	0.095	43.8	+	Tr.	0	seventh pregnancy
12/18/28	−7 mos.	Tr.			+	Tr.	0	Complicating toxemia
2/20/29	Term	0	0.050	42.8	0	0	0	Spontaneous delivery 2/22/29.
2/25/29	3 days P. P.	0	0.063	43.4	0	0	0	Child macerated, 2650 gm.
3/19/29	1 mo. P. P.	0			0	0	0	
			Eighth pregnancy					
3/11/30		0			0	0	0	L.M.P. 3/14/30
5/20/30	2 mos.	0			0	0	0	
7/ 8/30	−4 mos.	Tr.			Tr.	0	0	
9/30/30	6½ mos.	0			0	0	0	Complicating toxemia, probably
11/ 9/30	−8 mos.	1.5	0.085	45.3	0	0	0	nephritic
12/17/30	Term	0	0.081	39.0	0	0	0	Spontaneous delivery 12/19/30.
12/20/30	1 day P. P.	0	0.067		0	0	0	Child alive. Weight 3050 gm.
12/22/30	3 days P. P.	0	0.072		0	0	0	
12/27/30	8 days P. P.	0	0.090		0	0	0	Nursing baby
3/ 3/31	2½ mos. P. P.	+			0	0	0	Not keeping diet

This patient has a very mild diabetes which was apparently not aggravated by the two pregnancies which occurred under our observation. The fall in blood sugar during the early days of the puerperium is noteworthy. During both pregnancies there was a moderately severe toxemia, probably nephritic in origin.

during the first month of her present pregnancy and persisted for some time, although the daily insulin administration was increased to 40 units. By the seventh month of pregnancy, the urine was sugar-free, and by the eighth month it had been possible again to reduce the

insulin to 20 units. Labor was induced about three weeks before term because of a complicating nephritis, and a living child was obtained. The patient suckled her infant and by the seventeenth day of the

CASE 8

PATIENT M. P., UNIT 20,412, BORN 1908, BLACK

DATE	DURATION	URINE SUGAR PER DAY	BLOOD SUGAR	BLOOD CO_2	ACETONE	DIACETIC	UNITS INSULIN	REMARKS
		grams						
12/27/27		66.8			++	+	0	Diabetes diagnosed in 1927, at age of 19
2/28/28		Tr.			0	0	42	Diet and insulin necessary for control
				First pregnancy				
4/10/28		0			0	0	44	L.M.P. 4/6/28
6/ 5/28	2 mos.	0				+	40	
8/ 2/28	4 mos.	1.5			0	0	36	
10/ 9/28	6 mos.	0	0.068		0	0	36	
11/ 7/28	7 mos.	0			0	0	36	Insulin stopped 11/29/28 because of reactions.
12/ 8/28	4 days P. P.	6.75	0.041	42.8	0	0	0	Spontaneous delivery 12/4/28. Child alive. Weight 3260 gm.
12/19/28	15 days P. P.	1.8	0.035	39.0	Tr.	0	0	Duration of nursing unknown
2/ 7/29	2 mos. P. P.	4.5			0	0	0	
5/23/29	5½ mos. P. P.	60.0	0.118				0	Insulin begun again

This patient apparently presented a moderately severe diabetes in a young woman, diet and 42 units of insulin per day being necessary to keep the condition under control. During the pregnancy the insulin was cut down somewhat and finally, when she was 8 months pregnant, was dispensed with entirely because of rather severe reactions. During the puerperium a small amount of glycosuria was present constantly, despite a relative hypoglycemia, the blood sugar level falling to 0.035 mgm. the 15th day of the puerperium. The administration of insulin was not begun until 5½ months after delivery.

puerperium it had become possible to dispense entirely with insulin. It is interesting to note that one month after delivery glycosuria was again present, and coincidently the supply of breast milk had failed.

CASE 9

PATIENT E. M. B., UNIT 13,944, BORN 1887, WHITE

DATE	DURATION	URINE SUGAR PER DAY	BLOOD SUGAR	BLOOD CO_2	ACETONE	DIACETIC	UNITS INSULIN	REMARKS
		grams						
9/ 1/27		Tr.	0.240		+	0	15–25	Patient first seen with diabetic gangrene in August, 1927. History of diabetes for 5 years. Also had nephritis
2/ 3/28		0	0.098		0	0	0	
				Fifth pregnancy				
1/ 7/30		0			0	0	0	L.M.P. 1/18/30
2/18/30	1 mo.	0	0.130		0	0	0	
4/15/30	3 mos.	0			0	0	0	
6/17/30	5 mos.	0			0	0	0	
7/12/30	−6 mos.	0.84	0.116	47.5	0	0	0	Nephritic toxemia
8/28/30	+7 mos.	0	0.063	40.9	0	0	0	
9/29/30	+8 mos.	0	0.082	43.8	0	0	0	Foetal heart last heard 10/1/30
10/ 8/30	8½ mos.	++	0.133	50.4	0	0	0	
10/12/30	Day of delivery	+++	0.167		0	0	0	Spontaneous delivery. Child stillborn, macerated.
10/16/30	4 days P. P.	+	0.130	48.5	0	0	0	Weight 3175 gms.
10/19/30	7 days P. P.	Tr.	0.213	51.8	0	0	0	Severe mastitis in puerperium
10/27/30	15 days P. P.	0	0.154	48.5	0	0	0	
12/16/30	2 mos. P. P.	0	0.165		0	0	0	

This patient was first treated in the medical service for diabetic gangrene, where it was found possible to control the diabetes by diet alone. On only one occasion was glycosuria apparent during the first six months of the pregnancy. She was admitted to the obstetrical service on September 28, 1930, because of a toxemia of pregnancy, and was found to have a normal blood sugar and the urine was sugar-free. Ten days later, considerable glycosuria was present and the blood sugar had risen to 0.133 mgm. The patient had not felt foetal movements, nor was the foetal heart elicited, it having been last heard 7 days before. Four days later, October 12, 1930, the patient was delivered of a stillborn, badly macerated foetus. At this time there was marked glycosuria, and the blood sugar was 0.167 mgm. The sugar disappeared from the urine during the first two weeks of the puerperium, though the blood sugar continued elevated, possibly as the result of a simple mastitis causing considerable fever.

CASE 10

PATIENT J. L., UNIT 17,663, BORN 1888, WHITE

DATE	DURATION	URINE SUGAR PER DAY	BLOOD SUGAR	BLOOD CO_2	ACETONE	DIACETIC	UNITS INSULIN	REMARKS
		grams						
4/ 3/28		1.2%	0.254	58.4	+	0	30	Diabetes diagnosed in 1928
5/22/28		0	0.105		0	0	30	Insulin needed to keep sugar-free
				Ninth pregnancy				
5/10/30		0	0.135		0	0	32	L.M.P. 5/11/30
6/17/30	1 mo.	0	0.145		0	0	32	
7/17/30	2 mos.	0			0	0	32	
10/21/30	+5 mos.	80.0			0	0	38	
10/30/30	5½ mos.	57.0	0.179		+	+	38	
12/11/30	7 mos.	6.0			0	0	34	
12/26/30	7½ mos.	10.85	0.121	46.6	0	0	40	
1/11/31	8 mos.	0	0.108	44.7	0	0	32	
1/25/31	8½ mos.	0	0.105	41.9	0	0	26	Labor induced 2/4/31
2/ 6/31	2 days P. P.	0	0.073	44.7	0	+	26	Child alive. Weight 3500 gms.
2/11/31	1 wk. P. P.	Tr.	0.075		0	0	26	
2/17/31	13 days P. P.	0	0.085		0	0	26	
2/24/31	3 wks. P. P.	Tr.			0	0	26	Nursed baby until 2/24/31
3/ 3/31	1 mo. P. P.	Tr.			0	0	26	

This patient had a moderately severe diabetes, requiring 30 to 32 units of insulin together with a rather rigid diet to keep her sugar-free. No change was noted during the first 2 months of pregnancy. From the fifth to the eighth month, considerable glycosuria was constantly observed despite an increase to 40 units in the daily insulin administration. During the last month of pregnancy the urine was sugar-free and the insulin was cut down to 26 units. Throughout the early puerperium the blood sugar was lower than at any other time, even prior to the pregnancy. The insulin has been kept at 26 units and at no time has more than a trace of sugar appeared in the urine.

In a previous pregnancy this patient had gone without insulin for nine months after delivery and during that time she had successfully nursed her baby.

CASE 11

PATIENT C. E., UNIT 35,691, BORN 1914, WHITE

DATE	DURATION	URINE SUGAR PER DAY	BLOOD SUGAR	BLOOD CO_2	ACETONE	DIACETIC	UNITS INSULIN	REMARKS
		grams						
5/20/30		Tr.	0.055		0	0	55	Diabetes diagnosed and treated elsewhere since 1928, aged 14
				First pregnancy				
6/10/30		0			0	0	55	L.M.P. 6/8/30
7/29/30	1½ mos.	0			0	0	57	
9/11/30	3 mos.	0	0.075		0	0	54	
10/23/30	4½ mos.	0			Tr.	0	53	
11/25/30	5½ mos.	0			0	0	53	
12/18/30	+6 mos.	7.96			0	0	51	
1/15/31	+7 mos.	4.9	0.090		0	0	51	
2/17/31	+8 mos.	22.2			0	0	60	Admitted to hospital 2/20/31
2/22/31	8½ mos.	0	0.079	43.8	+	+	55	Complicating toxemia
2/26/31	8½ mos.	0	0.125		0	0	48	
3/ 4/31	−9 mos.	0	0.101	48.5	0	0	32	
3/10/31	Term	0	0.133		0	0	32	Spontaneous delivery, 3/11/31
3/12/31	1 day P. P.	0	0.152		0	0	32	Child alive, died, aged 6 days. Weight 2120 gms.
3/13/31	2 days P. P.	1.3	0.141		0	0	32	
3/14/31	3 days P. P.	1.56	0.141		0	0	32	
3/16/31	5 days P. P.	2.83	0.182		0	0	32	

In this patient the diabetes developed at the age of 14. The process was severe and 55 units of insulin per day was necessary to render the sugar under control. No change was noted until the sixth month of pregnancy was reached, when glycosuria appeared and persisted despite increase of the insulin to 60 units. That this apparent exacerbation of the condition was at least partly due to dietary indiscretion seems evident, since 2 days after admission to the hospital the urine was sugar-free. The insulin was rapidly reduced from 60 to 32 units without glycosuria appearing. The patient was delivered and the blood sugar promptly rose and sugar was present in the urine.

CASE 12

PATIENT E. R., UNIT 35,792, BORN 1893, WHITE

This patient was first seen when admitted through the Accident Room in deep coma. She was 8 months pregnant and had been unconscious for forty-eight hours. The blood sugar was found to be 0.770 mgm. and the CO_2 combining power 17.4 volumes per cent. Despite the administration of fluids and insulin, the patient never regained consciousness and died eight hours after admission.

Before passing to a discussion of the behavior of our patients during labor and the puerperium, we wish to present the course of the disease in a patient in whom the child died *in utero* some days prior to delivery (case 9). Mrs. E.M.B., a known diabetic for three years, went through the first eight months of her pregnancy without incident. The foetal heart was last heard and foetal movements last felt on October 1st, twenty-four days before the estimated date of confinement. One week later, the blood sugar had risen from 0.082 to 0.133 mgm. and glycosuria appeared. Four days later the patient was delivered of a stillborn, macerated foetus, and by this time the blood sugar was 0.167 mgm. and more sugar was present in the urine. The glycosuria disappeared during the first week of the puerperium, but the hyperglycemia persisted, being apparently due to a severe simple mastitis.

The course of labor was uneventful in most cases, although in several instances the pregnancy was terminated at some time during the last month because of a complicating toxemia. One patient on two occasions was delivered prematurely of a stillborn infant, but here autopsy revealed a congenital syphilis as the causative factor. The labors were not prolonged and did not seem to offer any undue strain to the patient. In some of our patients the diabetes reverted to its former status immediately after delivery. In the majority of cases, however, the improvement noted near the end of pregnancy persisted for varying lengths of time, in one instance for as long as nine months. In no case did any alarming symptoms appear during this period. Two patients (Nos. 5 and 8), presented a definite though asymptomatic hypoglycemia within seventy-two hours after delivery, the blood sugar falling to 0.047 and 0.035 mgm. and the condition persisting for thirteen and fifteen days, respectively.

Acetone and diacetic acid were occasionally found in the urine of several of the patients. It did not play a decisive rôle in any instance and was easily controlled by a small increase in the carbohydrate factor of the diet.

We cannot make any positive statement concerning the rôle of lactation in diabetic women. A study of the cases in this series, however, strongly suggests that it is of benefit to the patient, since the duration of improvement following delivery often coincides with the length of lactation. The table depicting the course in case 3 affords an excellent

illustration of this point. The patient was sugar-free throughout the early puerperium, and glycosuria first appeared one month after delivery at which time the supply of breast milk had almost disappeared. It would seem highly important that experimental work be done on this problem and this is being contemplated in the near future.

In five patients, the presence of a toxemia was a severe complicating factor from a clinical point of view. Joslin suggests that the upset carbohydrate metabolism in diabetics might well predispose to a toxemia developing during pregnancy. Three of our five women, however, undoubtedly had an arteriosclerotic type of nephritis, while the other two apparently had a toxemia of pregnancy. In these five cases, the accompanying hypertension and albuminuria necessitated a lowering of the protein content of the diet, otherwise, from the diabetic standpoint it played no rôle.

Excluding the patient dying undelivered in coma, we have followed eleven patients through seventeen pregnancies. There were five stillborn infants and one neonatal death. Four of the six fatalities, however, were in no way connected with the diabetic condition, as two were due to syphilis, one to premature separation of the placenta, and one to pemphigus. There remain two foetal deaths probably connected with the maternal disease. This gives a relatively better prognosis for the child than is usually suggested. In our series, there were no cases of hydramnios and only one instance of malformation, a meningocele resulting in operative cure. Also, there were only three infants above the average in size and in only one of these was the weight over 4000 grams.

The treatment of the diabetic woman during pregnancy, labor and the puerperium seems fairly clear. Whether or not the severe diabetic should be allowed to continue her pregnancy is still problematical. The average case, however, under careful supervision with diet and insulin, may quite safely be brought to term. During the first part of the pregnancy, the condition may become somewhat aggravated, necessitating rigid diet and increased insulin. Such control may be best established in the hospital and it seems advisable to admit such patients to the ward for a few days' study every two or three months during the pregnancy. The pregnant woman will tolerate a relatively high carbohydrate diet fairly well and in this way ketonuria may be

controlled. The insulin dosage can be established by a study of the blood and urine sugar before and after each meal of the day. During the last part of pregnancy an improvement will probably be noted, the dosage of insulin may be diminished, and a careful watch should be kept for hypoglycemic reactions. At the time of labor the patient will be in good condition from a diabetic standpoint and no difficulty is to be anticipated. During the puerperium the diabetes may revert at once to its state before the pregnancy, but the improvement noted during the last few months may persist for some time. Lactation seems advisable in these patients.

It is not desired in any way to make light of diabetes in the pregnant woman, as it is undoubtedly a serious complication. However, it is strongly felt that with careful supervision the average diabetic woman may relatively safely have her desired family and be left in no worse condition than before it.

CONCLUSIONS

1. A study of 17 pregnancies in 12 diabetic women indicates that the diabetes may become somewhat aggravated during the first two-thirds of pregnancy, but a definite improvement is to be expected as the patient approaches term.

2. Death of the foetus *in utero* may result in an immediate break of the diabetes from control.

3. The course of labor in such patients is not unfavorable and the puerperium seems to present no particular danger. A hypoglycemia during the early puerperium may become evident.

4. The improvement noted during the past part of pregnancy may persist for some weeks or months after delivery. The duration of such improvement is often coincident with lactation, and nursing may be safely continued as long as possible.

5. Toxemia is a frequent complicating factor.

6. The outcome to the child is not unfavorable.

7. Under careful supervision, there seems to be no reason why the average diabetic woman should not pass through a restricted child-bearing career with a reasonable degree of safety.

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